

THE DEMANDS OF NUCLEAR SAFETY:

MISHAPS AND USSTRATCOM

BY

MAJOR THOMAS A. KOORY

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APPROVAL

The undersigned certify that this thesis meets master's-level standards of research, argumentation, and expression.

Dr. Stephen E. Wright 2 June 2011

Colonel Edwin H. Redman 2 June 2011



DISCLAIMER

The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the US Government, Department of Defense, the United States Air Force, or Air University.



ABOUT THE AUTHOR

Maj Tommy Koory received his commission through the Reserve Officer Corps, Louisiana Tech University, in 1997. After graduating from Undergraduate Space and Missile Training in 1999, he served in operational and staff positions in missile warning and space surveillance operations, and as a missileer in intercontinental ballistic missile operations. He also served six months in Kuwait as an operations duty officer for an expeditionary air mobility squadron at the beginning of Operation Iraqi Freedom. He went on to serve three years as a space and missile assignments officer at the Air Force Personnel Center before attending Air Command and Staff College. Major Koory has a bachelor's degree in Mathematics from Louisiana Tech University, a master's degree in Business Administration from Central Michigan University, and a master's degree in Military Operational Art and Science from Air Command and Staff College.



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Most importantly, I want to express my sincere appreciation to my family, especially my beautiful wife and daughters for their love, patience, and understanding during those times when I was off struggling with this paper. My appreciation also goes out to my mom and brother, who among others, prayed for me, and especially to God for answering their prayers. Finally, I would like to dedicate this project to the memory of Charlene Marie Koory, who watched over me throughout this process; may she rest in peace.

ABSTRACT

This study addresses whether U.S. Strategic Command (USSTRATCOM) is postured to safely conduct the nuclear mission. The author uses two competing schools of thought from organization theory regarding safety in industries with hazardous technologies to assess the validity of his thesis that USSTRATCOM is not currently postured to safely conduct the nuclear mission. One, known as the high reliability school, claims appropriate organizational design and management techniques can safely manage extremely hazardous technologies. The other, known as the normal accidents school, claims serious accidents, while possibly rare, are inevitable over time, especially in technological systems with high degrees of interactive complexity and tight coupling.

The author uses Scott D. Sagan's ideas found in *The Limits of Safety* as the starting point for the analytical framework employed in this study. He evaluates USSTRATCOM's safety posture in relation to each of the high reliability school's four critical factors around the time of the 30 August 2007 Minot Air Force Base, North Dakota Bent Spear, first from the high reliability school's perspective, then from the normal accidents school's perspective, and finally in relation to any area of agreement between the two schools. Then, he examines actions taken by USSTRATCOM in response to the Bent Spear and assesses their impact on its current safety posture.

The purpose of this process is to identify any problems at USSTRATCOM that contributed to the Bent Spear, to evaluate whether the problems persist or not, and to assess whether USSTRATCOM is postured to safely conduct the nuclear mission. Additional clarity about which school provides the better approach to ensuring the safety of the nuclear arsenal and the requirements associated with this approach is also expected.

The conclusions are that both schools offer valuable insights for nuclear weapons safety, that USSTRATCOM contributed to the Bent Spear, and that USSTRATCOM is not postured to safely conduct the nuclear mission. Based on these conclusions, the author offers implications and recommendations for consideration.

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Introduction

To the degree that we become complacent, believing that the end of the Cold War has solved the problem of nuclear weapons safety, fewer of these problems will be identified and fixed. Someday, when we expect it least—during a military exercise, while transporting nuclear weapons to storage sites, during a missile flight test, or even during a routine missile maintenance operation—the unexpected will occur.

Scott D. Sagan

On 30 August 2007 the unexpected occurred. Ironically, the safety problem did not occur while transporting nuclear weapons *to* storage sites. Instead, the problem was that the Air Force mistakenly transported nuclear weapons *from* their storage sites, and no one realized the error for over 36 hours.¹ I am referring to the unauthorized transfer of nuclear weapons from Minot Air Force Base (AFB), ND, to Barksdale AFB, LA.² This incident, along with others, raised serious concerns about America's nuclear arsenal, and nuclear weapons safety and security in particular.

The subject of this study is nuclear weapons safety.³ Throughout this study, I use *safety* in the broad sense of the word, to encompass the many aspects of nuclear surety. Thus, in this study safety means “the materiel, personnel, and procedures that contribute to the safety,

¹ Michael Hoffman, “Nuclear Safety Slipped for Years Before Minot,” *Air Force Times*, 26 February 2008; Senate, *Air Force Nuclear Security: Hearing before the Committee on Armed Services*, 110th Cong., 2d sess., 12 February 2008, 2.

² Defense Science Board Task Force on Nuclear Weapons Surety, *Report on the Unauthorized Movement of Nuclear Weapons* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, April 2008), 1.

³ Specifically, this study is concerned with the safety of deployed warheads in active use versus non-deployed warheads or warheads awaiting dismantlement—see Department of Defense, *Nuclear Posture Review Report* (Washington, DC: April 2010), 37-38, for discussion.

security, reliability, and control of nuclear weapons, thus assuring no nuclear accidents, incidents, unauthorized use, or degradation in performance.”⁴ Nuclear weapons, especially thermonuclear weapons, have always required exacting safety standards and special consideration due to their political and military importance, destructive power, and the unacceptable costs associated with any accidental or unauthorized acts.⁵ Overall, the nuclear weapons safety record is commendable. Indeed, in the 66-year history of nuclear weapons, no nation has suffered an accidental or unauthorized nuclear detonation, or even worse, an accidental nuclear war.

Diminished Role for Nuclear Weapons

Since their use in 1945 to defeat Japan, the United States has primarily used nuclear weapons for deterrence. The reliance on nuclear weapons for deterrence became so prominent during the Cold War, that the term *nuclear deterrent* became synonymous with the nuclear triad of bombers, intercontinental ballistic missiles (ICBMs), and submarine-launched ballistic missiles (SLBMs).⁶ America successfully used nuclear weapons to deter the spectrum of possible Soviet attacks and avoid actual war with the Soviet Union.⁷ The United States also used nuclear weapons to deter chemical and biological attacks from a range of actors.⁸ Since the end of the Cold War, however, the altered security environment

⁴ Office of the Deputy Assistant to the Secretary of Defense for Nuclear Matters, “Nuclear Surety,” <http://www.acq.osd.mil/ncbdp/nm/nuclearweaponssurety.html#safety>.

⁵ See paragraph 4.2.1., DOD Directive (DODD) 3150.2, *DOD Nuclear Weapons System Safety Program*, 23 December 1996, 2.

⁶ For a comprehensive analysis, see Lawrence Freedman, *The Evolution of Nuclear Strategy*, 3rd ed. (New York: Palgrave Macmillan, 2003); Congressional Commission on the Strategic Posture of the United States, *America’s Strategic Posture: Final Report* (Washington, DC: United States Institute of Peace Press, 2009), 27; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase II Report: Review of the DoD Nuclear Mission* (Arlington, VA: December 2008), Chairman’s Opening Letter, 31.

⁷ Department of Defense, *Nuclear Posture Review Report*, vii-viii; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 5.

⁸ Department of Defense, *Nuclear Posture Review Report*, viii.

and attainment of unrivaled conventional military superiority have marginalized nuclear weapons' role in U.S. national security.⁹

With its conventional preeminence and shifting focus from nuclear to major conventional combat to today's irregular operations against terrorist networks, the push to diminish nuclear weapons' role in deterring non-nuclear attacks against the United States continues.¹⁰ In the 2010 Nuclear Posture Review, America declared that, while working toward the goal of a world free of nuclear weapons, "the United States will not use or threaten to use nuclear weapons against non-nuclear weapons states that are party to the NPT [Nuclear Non-Proliferation Treaty] and in compliance with their nuclear non-proliferation obligations."¹¹ It also committed to establishing the necessary conditions to allow it to "adopt a universal policy that deterring nuclear attack is the sole purpose of nuclear weapons."¹²

A natural tension exists between a focus on the current irregular conflicts and the long-standing effort to reduce and eventually eliminate reliance on nuclear weapons on one hand and the need to maintain "a safe, secure, and effective nuclear arsenal," to deter adversaries and assure allies who rely on America's protective nuclear umbrella on the other.¹³ If those directly responsible at the micro level for maintaining

⁹ Freedman, *Evolution of Nuclear Strategy*, 424-26, 464; Thomas G. Mahnken, *Technology and the American Way of War* (New York: Columbia University Press, 2008), 221; Benjamin S. Lambeth, *The Transformation of American Air Power*, (Ithaca, NY: Cornell University Press, 2000), 153; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, Chairman's Opening Letter; Strategic Posture Commission, *America's Strategic Posture*, xv; Defense Science Board Task Force on Nuclear Deterrence Skills, *Report* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, September 2008), 14.

¹⁰ Department of Defense, *Quadrennial Defense Review Report* (Washington, DC: 6 February 2006), vi-vii; President, *National Security Strategy* (Washington, DC: May 2010), 1; Department of Defense, *Nuclear Posture Review Report*, viii.

¹¹ Department of Defense, *Nuclear Posture Review Report*, iii, viii.

¹² Department of Defense, *Nuclear Posture Review Report*, viii.

¹³ The United States committed itself to working toward disarmament as a signatory to the 1970 NPT. See President, *National Security Strategy*, 23; Department of Defense, *Nuclear Posture Review Report*, iii, v-vi, xiv; Strategic Posture Commission, *America's*

the exacting safety standards for nuclear weapons do not adequately sense the weapons' political and military importance due to a macro-level imbalance, problems are likely to result.

With the end of the Cold War, nuclear weapons specialists found their role increasingly reduced along with the reduced role of nuclear weapons in the United States.¹⁴ Numerous reports throughout the post-Cold War period, both well before and after the 30 August 2007 unauthorized transfer incident, cited concerns and probable causes associated with the perceived devaluing of the nuclear deterrence mission and nuclear forces among nuclear specialists.¹⁵ Some of the specific concerns and likely causes included a declining focus on the nuclear mission across the Department of Defense (DoD) with a corresponding decrease in nuclear expertise, as well as inadequate senior level interest, advocacy, and appreciation of the continued necessity of a strong nuclear deterrent.¹⁶

Air Force Problems, Air Force Solutions

The 30 August 2007 unauthorized transfer, categorized as a Bent Spear in nuclear safety terms for significant incidents, occurred in this declining interest context.¹⁷ As noted, many reports that preceded and followed the Bent Spear cited problems throughout the DoD with regard to the nuclear mission. However, most of the blame and repercussions for the Bent Spear as well as another incident—the discovered shipment of four ICBM forward section reentry vehicle (RV) assemblies to Taiwan

Strategic Posture, xi; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 6; Freedman, *Evolution of Nuclear Strategy*, 443.

¹⁴ Freedman, *Evolution of Nuclear Strategy*, 463.

¹⁵ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 15-19; DSB Task Force on Nuclear Deterrence Skills, *Report*, vi-vii, 15, 59.

¹⁶ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 1, 15-19; DSB Task Force on Nuclear Deterrence Skills, *Report*, vi-vii, 59; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, Chairman's Opening Letter, iii.

¹⁷ Air Force Policy Directive (AFPD) 91-1, *Safety: Nuclear Weapons and Systems Surety*, 13 February 2007, 3.

by mistake—fell squarely on the Air Force.¹⁸ After the discovery of the mistaken shipment of the RV assemblies in March 2008, Defense Secretary Robert M. Gates appointed Admiral Kirkland Donald, then Director of Naval Propulsion, to conduct an investigation.¹⁹ The mistaken Taiwan shipment resulted from the failure of personnel at F.E. Warren AFB, WY, to put the proper top-secret classification markings on the assemblies' shipping containers before shipping them to a Defense Logistics Agency (DLA) storage depot at Hill AFB, UT.²⁰ DLA personnel later misidentified them as helicopter batteries and shipped them to Taiwan.²¹ Admiral Donald's report, completed in June 2008, identified systemic and institutional nuclear stewardship problems and a common origin for both incidents: "the gradual erosion of nuclear standards and a lack of effective oversight by Air Force leadership."²²

In light of the report's findings, Secretary Gates took decisive action. He asked for and received the resignations of both the Secretary of the Air Force, Mr. Michael W. Wynne and the Air Force Chief of Staff, General T. Michael Moseley.²³ In addition to this unprecedented action, he also appointed a Task Force, led by former Defense Secretary Dr. James Schlesinger, to examine nuclear stewardship in two phases: first, within the Air Force, and second, across the entire DoD.²⁴ The Task Force marked the latest in a series of investigations and reports that

¹⁸ Department of Defense, *Transcript: DoD News Briefing with Secretary Gates from the Pentagon* (Washington, DC: Office of the Under Secretary of Defense for Public Affairs, 5 June 2008), 1-4.

¹⁹ Department of Defense, *DoD News Briefing with Secretary Gates*, 1.

²⁰ Michael Hoffman, "Nuke Safety Was Issue Long Before Moseley-Wynne Era-But 'Serious, Systemic Problem' May Have Worsened," *Air Force Times*, 16 June 2008.

²¹ Michael Hoffman, "Nuke Safety Was Issue Long Before Moseley-Wynne Era-But 'Serious, Systemic Problem' May Have Worsened," *Air Force Times*, 16 June 2008.

²² Quoted in Department of Defense, *DoD News Briefing with Secretary Gates*, 2—Admiral Donald's actual report is classified, but Secretary Gates referenced unclassified excerpts from it during his briefing.

²³ Department of Defense, *DoD News Briefing with Secretary Gates*, 3.

²⁴ Department of Defense, *DoD News Briefing with Secretary Gates*, 2-3.

occurred in the wake of the Bent Spear and the mistaken Taiwan RV assemblies' shipment.²⁵

By the time the task force released its phase one report with 33 recommendations in September 2008, the Air Force was working to address its nuclear shortfalls and the findings and recommendations from the various reports via its own nuclear task force, which produced *Reinvigorating the Air Force Nuclear Enterprise* on 24 October 2008.²⁶ The reinvigoration plan incorporated the findings and recommendations from applicable reports and identified over 100 action items to remove the nuclear mission from caretaker status and restore the efficacy of the Air Force's nuclear stewardship.²⁷ A number of key organizational changes were included among the implemented action items: consolidation of nuclear sustainment within the Air Force Nuclear Weapons Center, assigning all operational ICBM and nuclear-capable bomber units to a new major command—Air Force Global Strike Command (AFGSC), and consolidation of all Air Force headquarters nuclear functions under a new directorate—Air Force A10.²⁸ The intent of the changes was to “enable coherent lines of authority, drive institutional focus, and ensure unambiguous accountability for the nuclear mission.”²⁹ Clearly, the Air Force received a much-needed course correction with regard to the nuclear mission, but what about the other DoD organizations with problems identified in applicable reports?

²⁵ See Senate, *Air Force Nuclear Security*, 1-68, for a comprehensive list of all Bent Spear related investigations and reports to February 2008.

²⁶ For a complete list of the Schlesinger task force's recommendations, see Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase I Report: The Air Force's Nuclear Mission* (Arlington, VA: September 2008), 8-11; For a comprehensive definition of the Air Force nuclear enterprise, see Department of the Air Force, *Reinvigorating the Air Force Nuclear Enterprise* (Washington, DC: Air Force Nuclear Task Force, 24 October 2008), 12; or see Senate, *Air Force Nuclear Security*, 21, for a more concise definition.

²⁷ Department of the Air Force, *Reinvigorating the Air Force Nuclear Enterprise*, 1; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, iii.

²⁸ Department of the Air Force, *Reinvigorating the Air Force Nuclear Enterprise*, 5-6, 16-17.

²⁹ Department of the Air Force, *Reinvigorating the Air Force Nuclear Enterprise*, 9.

United States Strategic Command (USSTRATCOM)

The focus of this study is on USSTRATCOM's readiness to safely conduct the nuclear mission. Since its inception in 1992, USSTRATCOM has been the DoD focal point for the nuclear deterrence mission, with responsibility for the planning, targeting and wartime employment of strategic nuclear forces.³⁰ As such, it has a critical role to play not only in ensuring the nuclear arsenal's effectiveness and readiness, but its safety and security as well.³¹ Indeed, per DoD Directive 3150.2, combatant commanders shall "ensure the safety and security of all nuclear weapons and nuclear weapons systems for which the combatant command has responsibility."³² USSTRATCOM has either direct responsibility for strategic nuclear forces, when they are postured to mission-ready alert status, or indirect responsibility, as a demanding customer of the force providers (Air Force and Navy), when such weapons are off alert or on standby alert, due to the potential requirement to generate to full-alert status on short notice.³³

Many of the problems identified at USSTRATCOM mirrored those found across the DoD—declining nuclear expertise and focus on the nuclear mission, inadequate senior level interest, weak advocacy, and a lack of appreciation of the continued necessity of a strong nuclear deterrent. These problems manifested themselves in inadequate oversight, inspections, exercises, resources, training, and proficiency.³⁴ To what extent did these problems contribute to the Bent Spear and other incidents that occurred around the same timeframe? More

³⁰ United States Strategic Command, "History," <http://www.stratcom.mil/history>.

³¹ House Committee on Armed Services, *Statement of General C. Robert Kehler, Commander, United States Strategic Command, before the Subcommittee on Strategic Forces*, 112th Cong., 1st sess., 2 March 2011, 3.

³² See paragraph 5.4-5.4.1., DOD Directive (DODD) 3150.2, *DOD Nuclear Weapons System Safety Program*, 23 December 1996, 4-5.

³³ Department of Defense, *Nuclear Posture Review Report*, 27.

³⁴ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7, 11, 13, 18; DSB Task Force on Nuclear Deterrence Skills, *Report*, vi, viii-ix, 36-37, 55; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, ix-x, 34-35, 53-58, 65.

importantly, what actions did USSTRATCOM take in response to these incidents, and did the actions adequately address the problems? Most importantly, as the DoD focal point for the nuclear deterrence mission, is USSTRATCOM postured to safely conduct the nuclear mission?

Problem, Focus, Thesis, and Methodology

The purpose of this study is *not* to explore the merits of maintaining a nuclear arsenal. As long as nuclear weapons exist, the United States is committed to maintaining a “safe, secure, and effective arsenal.”³⁵ Proponents and opponents of maintaining an arsenal agree on the abiding need for nuclear weapons safety. The relevant question is what is the right approach and what are the requirements associated with this approach? Clearly, as the Air Force painfully learned, the caretaker approach failed. In the wake of the Bent Spear, USSTRATCOM and the Air Force took many actions in an effort to address the problems. The issue now is to determine whether these actions are enough to ensure the current and future safety of the nuclear arsenal.

Again, the focus of this study is on USSTRATCOM’s readiness to safely conduct the nuclear mission. It is beyond the scope of this paper to examine the entire DoD’s readiness. Indeed, many of the issues associated with nuclear arsenal go well beyond the DoD.³⁶ I have chosen to examine USSTRATCOM’s readiness for two reasons. First, and rightfully so, much of the initial scrutiny and actions associated with fixing the problems that led to the Bent Spear have centered on the Air Force, while far less have centered on USSTRATCOM. Second, and more importantly, USSTRATCOM is the focal point for the nuclear deterrence mission within the DoD. As the warfighting command, it sets the tone and must take the lead in all aspects of the mission—safety, security,

³⁵ Department of Defense, *Nuclear Posture Review Report*, iii, xiv; President, *National Security Strategy*, 23.

³⁶ For a comprehensive assessment beyond the DoD, see DSB Task Force on Nuclear Deterrence Skills, *Report*, 8, Chapters 2, 4-5, 8, 10-11.

effectiveness, and readiness.³⁷ The best-developed, maintained, and supported nuclear weapons systems, combined with the best-organized, trained, and equipped nuclear forces, mean little in terms of deterrent value if USSTRATCOM is not fully engaged and fully prepared to plan, target, and employ them.

My thesis is USSTRATCOM is not currently postured to safely conduct the nuclear mission. I will assess the validity of my thesis by using two competing schools of thought from organization theory regarding safety in industries with hazardous technologies. One, known as the high reliability school, claims that organizations with appropriate design and management techniques can safely manage extremely hazardous technologies, making serious accidents a very rare occurrence.³⁸ The other, known as the normal accidents school, claims serious accidents, while possibly rare, are inevitable over time, especially in technological systems with high degrees of interactive complexity and tight coupling.³⁹ Which school better applies to the current nuclear arsenal? Additionally, which school provides a better approach to ensuring the safety of the nuclear arsenal, and what are the requirements associated with this approach? Finally, what insights from the two schools apply to determining whether USSTRATCOM is postured to safely conduct the nuclear mission?

The layout of this study is straightforward. I cover the methodology in chapter 2, where I analyze the two competing schools' views, claims, requirements, and applicability to the current nuclear arsenal and to the assessment of USSTRATCOM's nuclear weapons safety posture. From chapter 2, I use the four interrelated factors the high reliability school claims are necessary and sufficient to make

³⁷ House Committee, *Statement of General C. Robert Kehler*, 3.

³⁸ Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton, NJ: Princeton University Press, 1993), 14, 48.

³⁹ Sagan, *Limits of Safety*, 13, 28, 32.

accidents in industries with hazardous technologies extremely rare, as the basis for chapters 3 through 6. In each of these chapters, I provide an overview of the high reliability school's claims for one of the factors and cover the counterclaims made by the normal accidents school about the factor along with any areas of overlap or agreement. These sections summarize the material about each factor in Scott D. Sagan's *The Limits of Safety*. Then, I analyze USSTRATCOM's safety posture in relation to the factor around the time of the Bent Spear. I do so first from the high reliability school's perspective, then from the normal accidents school's perspective, and finally in relation to any area of agreement between the two schools. Finally, for each factor, I examine relevant actions taken by USSTRATCOM in response to the Bent Spear and assess their impact on its safety posture. Chapter 8 presents the implications, recommendations, and conclusions of this study. First, however, in chapter 1 I provide some needed background information about how USSTRATCOM became the unified command it is today.

Chapter 1

USSTRATCOM's Evolution

The reduction of the level of focus on the nuclear mission in U.S. Strategic Command is a natural result of the growth in global missions assigned to that command with a consequent dilution of the nuclear mission.

*Defense Science Board Task Force on Nuclear Weapons
Surety*

Historical Background

Given the long history of nuclear weapons in the United States, it may be surprising to know USSTRATCOM has only existed since 1 June 1992.¹ The United States, of course, has had nuclear weapons since 1945, but at first, the only option for delivery was strategic bombers such as the B-29 and later the B-52 and B-2. The Strategic Air Command (SAC) came into existence in 1946 with initial control of all strategic bombers and thus all nuclear forces.² Therefore, when the Air Force emerged as a separate service in 1947, SAC already existed as a warfighting command in addition to serving as an Air Force major command.

As a specified command, SAC was a unique entity for much of the Cold War, established by the president, through the secretary of defense with the advice and assistance of the Joint Chiefs of Staff (JCS), with a broad, continuing mission, but composed of forces from one service.³

¹ United States Strategic Command, "History," <http://www.stratcom.mil/history>.

² Norman Polmar and Timothy M. Laur, eds., *Strategic Air Command: People, Aircraft, and Missiles*, 2nd ed. (Baltimore, MD: The Nautical & Aviation Publishing Company of America, Inc., 1990), xi.

³ Air University Extension Course Institute 3B-15, *Unified and Specified Commands*, (Gunter AFB, AL: 1965), 1; for definitions and establishment provisions for combatant

Thus, SAC had organize, train, and equip responsibilities under the Air Force as a major command, along with operational planning, targeting, and employment responsibilities under the JCS (pre Goldwater-Nichols Act), typically only given to unified commands.⁴

Over time, the military added other options for nuclear weapons delivery. In 1958, ICBMs became part of SAC with the fielding of the Atlas and Titan systems.⁵ The Navy's Polaris SLBM became operational in 1960, providing the final leg of the strategic nuclear triad (bombers, ICBMs, and SLBMs).⁶

In order to synchronize the three legs of the triad, the JCS created the Joint Strategic Target Planning Staff (JSTPS) in 1960 to integrate the plans and initial operations of all nuclear strike forces.⁷ As a JCS agency, the JSTPS had representatives from all the services and unified commands with nuclear missions and operated from SAC headquarters where the SAC commander served as its director.⁸ It produced and maintained the National Strategic Target List, the master list of all strategic targets, and the Single Integrated Operational Plan, the U.S. strategic war plan, thus ensuring unity of effort in the event of nuclear war.⁹ This arrangement continued through the remainder of the Cold War—joint planning and targeting by JSTPS along with employment under SAC, while organize, train, and equip responsibilities remained

commands (unified and specified commands), see Combatant Commands: Establishment, *US Code 10, sec. 161*, (2010).

⁴ See Table 1, Defense Science Board Task Force on Nuclear Weapons Surety, *Report on the Unauthorized Movement of Nuclear Weapons* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, April 2008), 10-11.

⁵ Polmar and Laur, *Strategic Air Command*, xi.

⁶ Department of the Navy, "Polaris Fleet Ballistic Missile Weapon System," in Air University Extension Course Institute 3B-15, *Unified and Specified Commands*, 103.

⁷ Strategic Air Command, "Joint Strategic Planning Staff Gives President 'Packaged Plans' for Nuclear Strikes," in Air University Extension Course Institute 3B-15, *Unified and Specified Commands*, 94.

⁸ Strategic Air Command, "JSTPS Gives President 'Packaged Plans'," 94.

⁹ Strategic Air Command, "JSTPS Gives President 'Packaged Plans'," 94-95.

with the Air Force under SAC, and Navy under its Atlantic and Pacific Fleets.¹⁰

In the wake of the Cold War and Operation Desert Storm, the Air Force reorganized, recognizing the blurred line between strategic and tactical air power.¹¹ This involved eliminating SAC along with Tactical Air Command and placing all combat aircraft under the new Air Combat Command. SAC and JSTPS stood down on 1 June 1992, the same day President George H. W. Bush established USSTRATCOM.¹² USSTRATCOM assumed responsibility for targeting, planning, and employment of strategic nuclear forces, while the Air Force and Navy retained organize, train, and equip responsibilities.¹³

Thus, initially USSTRATCOM was very much a continuation of SAC and JSTPS. It had the same mission, the same forces, the same command and control (C2) system, and even occupied the same headquarters building at Offutt AFB, NE, the LeMay Building. For the remainder of the 1990s, USSTRATCOM's mission and focus were the same, nuclear deterrence. This changed soon after 9/11, a period characterized by mission proliferation at USSTRATCOM.¹⁴

Since 9/11, USSTRATCOM has gained seven additional global missions. In 2002, to make way for the new U.S. Northern Command (USNORTHCOM), USSTRATCOM assumed the responsibilities of U.S. Space Command (USSPACECOM), which had existed since 1985, and inherited its space operations, missile defense, and information operations (IO) missions.¹⁵ In 2003 USSTRATCOM took ownership of the previously unassigned (non-nuclear) global strike and C4ISR (command

¹⁰ Department of the Navy, "Polaris Fleet Ballistic Missile Weapon System," 103.

¹¹ Thomas A. Hughes, *Over Lord: General Pete Quesada and the Triumph of Tactical Air Power in World War II*, (New York: The Free Press, 1995), 19.

¹² United States Strategic Command, "History," <http://www.stratcom.mil/history>.

¹³ United States Strategic Command, "History," <http://www.stratcom.mil/history>.

¹⁴ Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase II Report: Review of the DoD Nuclear Mission* (Arlington, VA: December 2008), 53.

¹⁵ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53.

and control, communications, computers, intelligence, surveillance, and reconnaissance) missions, along with expanded missile defense and IO responsibilities.¹⁶ In 2006, it gained the global network operations (GNO) and combating weapons of mass destruction (WMD) missions.¹⁷ In 2010, U.S. Cyber Command (USCYBERCOM) became operational as a sub-unified command to USSTRATCOM, combining the network operations—defensive—and network warfare—offensive—portions of the cyber mission.¹⁸

Much of the rationale behind this mission growth is traceable to the 2001 Nuclear Posture Review (NPR), which envisioned a reduced role for nuclear forces in deterrence, while expanding potential strategic options for the president and secretary of defense to consider in the event of a crisis.¹⁹ In addition to a potential nuclear response, the new deterrence strategy articulated in the 2001 NPR included non-nuclear strike options (both kinetic and non-kinetic), active and passive defenses combined with warning capability, and responsive weapons infrastructure, all enabled by enhanced C2, intelligence, and planning.²⁰ The *new strategic triad*, shown below, embodied this new strategy.

¹⁶ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53; United States Strategic Command, “History,” <http://www.stratcom.mil/history>.

¹⁷ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53.

¹⁸ United States Strategic Command, “Cyber Command Fact Sheet,” http://www.stratcom.mil/factsheets/Cyber_Command/.

¹⁹ Robert D. Critchlow, *Nuclear Command and Control: Current Programs and Issues*, (Washington, DC: Congressional Research Service, The Library of Congress, 3 May 2006), 9-11.

²⁰ Critchlow, *Nuclear Command and Control*, 9-10; United States Strategic Command, “History,” <http://www.stratcom.mil/history>.

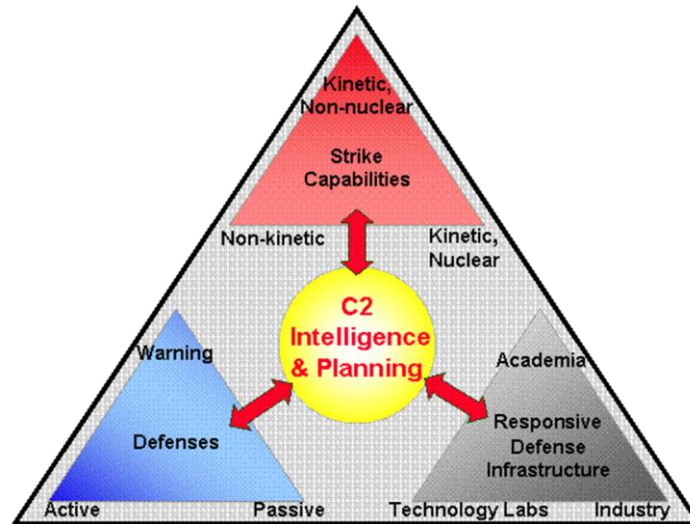


Figure 1: New Strategic Triad

Source: USSTRATCOM Mission Briefing, version 09-10

The new triad vividly displayed the diminished role of nuclear weapons in the new deterrence strategy and encompassed four different triads. The nuclear triad, referred to as *kinetic, nuclear*, occupied just one corner of the new *strike capabilities* triad. It joined the new *defenses* triad and the new *responsive defense infrastructure* triad. Enhanced C2, intelligence, and adaptive planning capabilities—center of the new triad—linked and supported the three new triads.

Implementation of the 2001 NPR's new deterrence strategy, embodied in the new triad, is a key reason behind USSTRATCOM's mission growth, which institutionalized the NPR's post-Cold War view of the strategic environment.²¹ The new triad was more vision than reality and might become a historical footnote associated with the George W. Bush Administration, since none of the pertinent security documents released under the current administration mentions it. However, many of the ideas it represented persist and are still evident at USSTRATCOM.

Scope of Current Missions

Due to its assigned missions, the term *functional combatant command* is not adequate to describe USSTRATCOM's role in the DoD. It

²¹ Critchlow, *Nuclear Command and Control*, 9-11.

is truly a global command, with responsibility for eight global missions (nuclear deterrence, space operations, cyberspace operations, missile defense, IO, global strike, ISR, and combating WMD).²² Implicit within the eight missions is ownership of two of the five distinct operational domains, space and cyberspace, where America has many vulnerabilities such as satellite signal jamming and cyber network hacking.²³ These two domains are the newest in terms of operating in and through them, and the United States is increasingly reliant upon capabilities from these contested domains, not just for effective combat operations, but also for everyday civilian life.²⁴

The previously unassigned global strike and C4ISR missions came with the requirement to build effective oversight and implementation capabilities from scratch, since no combatant command had previous ownership of these missions. Missile defense, along with its technical challenges, remains politically sensitive. The United States must carefully balance the need to protect itself from limited strikes without encouraging a missile buildup in countries such as Russia or China.²⁵ The recent decision to pursue regional approaches tailored to each region further complicates the missile defense mission.²⁶ The IO mission has played an increasingly important role in the current conflicts in Iraq and Afghanistan, characterized by counterinsurgency, counterterrorism, and stability operations, where the government's legitimacy in the eyes of its

²² House Committee on Armed Services, *Statement of General C. Robert Kehler, Commander, United States Strategic Command, before the Subcommittee on Strategic Forces*, 112th Cong., 1st sess., 2 March 2011, 1.

²³ Department of Defense, *Quadrennial Defense Review Report* (Washington, DC: February 2010), 33, 37-38, 92.

²⁴ President, *National Security Strategy* (Washington, DC: May 2010), 8, 17-18, 22, 27-28, 31, 49-50.

²⁵ Congressional Commission on the Strategic Posture of the United States, *America's Strategic Posture: Final Report* (Washington, DC: United States Institute of Peace Press, 2009), 32.

²⁶ Department of Defense, *Ballistic Missile Defense Review Report*, (Washington, DC: February 2010), 47-48.

people is crucial to victory.²⁷ Finally, combating WMD and nuclear deterrence have only grown more complex in the dynamic post-Cold War strategic environment.²⁸

In addition, USSTRATCOM's mission set reflects great breadth and importance and further establishes its unique role in the DoD. One indication of the breadth of USSTRATCOM's missions is evident in the fact that it does not have a true *mission* statement, but rather a *missions* statement.²⁹ Another indication of the scope and importance of USSTRATCOM's missions: three of the four recently completed congressionally mandated reviews (Quadrennial Defense Review (QDR), NPR, Ballistic Missile Defense Review, and Space Posture Review) correspond directly to USSTRATCOM missions, and though it addresses the broad DoD mission, the QDR stresses the importance of USSTRATCOM's various missions.³⁰ Finally, the scope and importance of USSTRATCOM's missions are clearly evident in the recent words of one senior defense official who said, "The challenges related to the U.S. nuclear posture, missile defenses, counter-WMD efforts, access to space, and cyber security are among the most pressing and difficult the Department of Defense is addressing today."³¹ In short, no other unified command compares to USSTRATCOM in terms of the vast complexity, breadth, and importance of its mission set.

Loss of Focus on Nuclear Mission

²⁷ Department of Defense, *Quadrennial Defense Review Report*, 25; David Kilcullen, *The Accidental Guerilla: Fighting Small Wars in the Midst of a Big One* (New York: Oxford University Press, 2009), 265.

²⁸ Defense Science Board Task Force on Nuclear Deterrence Skills, *Report* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, September 2008), 9-11; Strategic Posture Commission, *America's Strategic Posture*, 16; Department of Defense, *Nuclear Posture Review Report* (Washington, DC: April 2010), iv-v, 3-4, 9-13; President, *National Security Strategy*, 4, 7-8, 17, 23.

²⁹ United States Strategic Command, "STRATCOM Snapshot," <http://www.stratcom.mil/factsheets/snapshot/>.

³⁰ See Department of Defense, *Quadrennial Defense Review Report*, contents page.

³¹ House Committee on Armed Services, *Statement of Dr. James N. Miller, Principal Under Secretary of Defense for Policy, before the Subcommittee on Strategic Forces*, 111th Cong., 2d sess., 16 March 2010, 14.

One clear result of the mission proliferation at USSTRATCOM, which came without the necessary manpower authorizations and personnel, was the loss of focus on the nuclear mission.³² The following example from the 2008 Task Force on DoD Nuclear Weapons Management, *Phase II Report*, clearly illustrates this point (note: the Task Force conducted its review in the latter part of 2008). “Prior to the 2002 merger of USSPACECOM and USSTRATCOM, the senior leader with undivided daily focus on the nuclear mission area was the Commander, USSTRATCOM, a four-star general or flag officer. During the Task Force review, the most senior officer at USSTRATCOM with a purely nuclear focus was an Air Force colonel. As a result, the nuclear mission was severely disadvantaged when competing for the attention of senior leaders within the organization.”³³ USSTRATCOM addressed this shortcoming somewhat in December 2008 by establishing and filling a one-star general officer position within its operations directorate (J3).³⁴

To cope with the mission growth, USSTRATCOM created Joint Functional Component Commands (JFCCs) in 2005.³⁵ The JFCCs, essentially sub-unified commands, have operational planning, force execution, and day-to-day management authority for USSTRATCOM’s various missions.³⁶ With JFCCs established, USSTRATCOM headquarters focused on strategic-level integration and advocacy of assigned missions.³⁷ It also sought to leverage the expertise and capabilities of organizations already engaged in the various missions by

³² Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53-58; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7, 11, 13, 18; DSB Task Force on Nuclear Deterrence Skills, *Report*, 52, 55.

³³ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 56.

³⁴ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 56.

³⁵ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53; United States Strategic Command, “History,” <http://www.stratcom.mil/history>.

³⁶ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53; United States Strategic Command, “History,” <http://www.stratcom.mil/history>.

³⁷ United States Strategic Command, “History,” <http://www.stratcom.mil/history>.

aligning the JFCCs with them.³⁸ USSTRATCOM now consists of its headquarters staff (J0-J9), four JFCCs (Global Strike (GS), Space, Integrated Missile Defense (IMD), and ISR), the Joint Information Operations Warfare Center (JIOWC)—another functional component, the USSTRATCOM Center for Combating Weapons of Mass Destruction (SCC-WMD)—the final functional component, and USCYBERCOM.³⁹

The JFCCs and their aligned organizations usually have collocated headquarters and share the same commander or director. For instance, JFCC-Space, aligned with Fourteenth Air Force, both have headquarters and the same commander at Vandenberg AFB, CA.⁴⁰ USCYBERCOM, aligned with the National Security Agency, share a headquarters and the same commander at Fort Meade, MD.⁴¹ Likewise, JFCC-IMD, aligned with the Army's Space and Missile Defense Command, both have headquarters and the same commander at Schriever AFB, CO.⁴² JFCC-ISR, aligned with the Defense Intelligence Agency, both have headquarters and the same commander at Bolling AFB, Washington DC.⁴³ JIOWC, located at Lackland AFB, TX, was a subordinate command of USSPACECOM and became part of USSTRATCOM in 2002

³⁸ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53.

³⁹ United States Strategic Command, "About USSTRATCOM," <http://www.stratcom.mil/about/>; United States Strategic Command, "Functional Components," http://www.stratcom.mil/functional_components/.

⁴⁰ United States Strategic Command, "JFCC-Space Fact Sheet," <http://www.stratcom.mil/factsheets/JFCC - SPACE/>; United States Strategic Command, "Mission Briefing," ver. 09-10.

⁴¹ United States Strategic Command, "Cyber Command Fact Sheet," http://www.stratcom.mil/factsheets/Cyber_Command/; United States Strategic Command, "Mission Briefing," ver. 09-10.

⁴² United States Strategic Command, "JFCC-IMD Fact Sheet," <http://www.stratcom.mil/factsheets/JFCC - Integrated Missile Defense/>; United States Strategic Command, "Mission Briefing," ver. 09-10.

⁴³ United States Strategic Command, "JFCC-ISR Fact Sheet," <http://www.stratcom.mil/factsheets/JFCC - Intelligence Surveillance and Reconnaissance/>; United States Strategic Command, "Mission Briefing," ver. 09-10.

as part of the merger.⁴⁴ Finally, SCC-WMD, aligned with the Defense Threat Reduction Agency (DTRA), both have headquarters and the same commander at Fort Belvoir, VA.⁴⁵

JFCC-GS is the exception. Aligned with eighth Air Force at Barksdale AFB, LA—the Air Force component responsible for nuclear bombers—they share the same commander, but have separate headquarters.⁴⁶ JFCC-GS plans and executes USSTRATCOM’s nuclear mission and conducts strike planning for non-nuclear and non-kinetic operations.⁴⁷ It remained headquartered along with USSTRATCOM at Offutt AFB, NE, because it still performs many of its key functions such as nuclear targeting and force monitoring within the USSTRATCOM headquarters building.⁴⁸ The transfer of these critical functions to JFCC-GS was a significant departure from the centralized control of the nuclear mission that once characterized USSTRATCOM.⁴⁹

USSTRATCOM also retained six nuclear task forces (TFs), aligned with Navy and Air Force organizations, which it has had since its inception. TF 294/Eighteenth Air Force, headquartered at Scott AFB, IL, conducts aerial refueling.⁵⁰ TF 124/Strategic Communications Wing One, headquartered at Tinker AFB, OK, operates Navy E-6B aircraft, also

⁴⁴ United States Strategic Command, “JIOWC Fact Sheet,” http://www.stratcom.mil/factsheets/Joint_Information_Operations_Warfare_Command/; United States Strategic Command, “Mission Briefing,” ver. 09-10.

⁴⁵ United States Strategic Command, “SCC-WMD Fact Sheet,” http://www.stratcom.mil/factsheets/USSTRATCOM_Center_for_combating_Weapons_of_Mass_Destruction/; United States Strategic Command, “Mission Briefing,” ver. 09-10.

⁴⁶ United States Strategic Command, “JFCC-GS Fact Sheet,” http://www.stratcom.mil/factsheets/JFCC_-_Global_Strike/; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53; United States Strategic Command, “Mission Briefing,” ver. 09-10.

⁴⁷ United States Strategic Command, “JFCC-GS Fact Sheet,” http://www.stratcom.mil/factsheets/JFCC_-_Global_Strike/; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53.

⁴⁸ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53.

⁴⁹ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53.

⁵⁰ United States Strategic Command, “Task Forces,” http://www.stratcom.mil/task_forces/; United States Strategic Command, “Mission Briefing,” ver. 09-10.

known as TACAMO (Take Charge and Move Out), to provide a survivable communications link between the president and nuclear forces.⁵¹ TF 134/Submarine Forces Pacific Fleet, with headquarters at Naval Base Pearl Harbor, HI, controls Pacific ballistic missile submarines.⁵² TF 144/Submarine Forces Atlantic Fleet, headquartered at Naval Base Norfolk VA, controls Atlantic ballistic missile submarines.⁵³ TF 204/Eighth Air Force, with headquarters at Barksdale AFB, LA, provides B-52 and B-2 nuclear bombers, as well as RC-135 and U-2S reconnaissance aircraft.⁵⁴ Finally, TF 214/Twentieth Air Force, headquartered at F.E. Warren AFB WY, provides ICBMs.⁵⁵

The following illustration shows just how complicated the nuclear hierarchy has become under USSTRATCOM: The same two-star Air Force general, Major General Floyd L. Carpenter, now commands Eighth Air Force, TF 204, and JFCC-GS with separate headquarters at Barksdale AFB and Offutt AFB. As JFCC-GS, he is now responsible for what used to be USSTRATCOM's sole mission, nuclear deterrence, along with non-kinetic and kinetic, non-nuclear strike capabilities,

⁵¹ United States Strategic Command, "Task Forces," http://www.stratcom.mil/task_forces/; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 40; United States Strategic Command, "Mission Briefing," ver. 09-10.

⁵² United States Strategic Command, "Task Forces," http://www.stratcom.mil/task_forces/; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 40; United States Strategic Command, "Mission Briefing," ver. 09-10.

⁵³ United States Strategic Command, "Task Forces," http://www.stratcom.mil/task_forces/; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 40; United States Strategic Command, "Mission Briefing," ver. 09-10.

⁵⁴ United States Strategic Command, "Task Forces," http://www.stratcom.mil/task_forces/; United States Strategic Command, "Mission Briefing," ver. 09-10.

⁵⁵ United States Strategic Command, "Task Forces," http://www.stratcom.mil/task_forces/; United States Strategic Command, "Mission Briefing," ver. 09-10.

encompassing the new *strike capabilities* triad within the new triad.⁵⁶ In contrast, as Eighth Air Force/TF 204 commander, he controls just one leg of the nuclear triad.⁵⁷ Additionally, although he is co-equal with the other TF commanders under USSTRATCOM, as JFCC-GS commander, the other TF commanders are subordinate to him, despite the fact he is outranked by the TF 144 commander, a three-star Navy admiral and the TF 294 commander, a three-star Air Force general.⁵⁸

To summarize, USSTRATCOM began very much as a continuation of SAC and remained focused on the nuclear mission until 2002. At that crucial point, in the aftermath of 9/11, the need to sustain its focus became more critical than ever as the DoD as a whole shifted its focus further away from nuclear weapons to fight the *war on terror*. Then, USSPACECOM merged with USSTRATCOM to make room for USNORTHCOM. Simultaneously, implementation of the 2001 NPR's new deterrence strategy—embodied in the new triad—began, which deemphasized the role of nuclear weapons. This confluence of events began the spiral of mission growth at USSTRATCOM, that along with headquarters downsizing and the JFCC structure, although reasonable under the circumstances, has impaired USSTRATCOM's ability to "remain focused and actively engaged in the daily operation of the nuclear mission."⁵⁹ This in turn resulted in a lack of adequate oversight and support of the nuclear mission.⁶⁰

⁵⁶ United States Strategic Command, "JFCC-GS Fact Sheet," [http://www.stratcom.mil/factsheets/JFCC - Global Strike/](http://www.stratcom.mil/factsheets/JFCC_-_Global_Strike/); United States Strategic Command, "Mission Briefing," ver. 09-10.

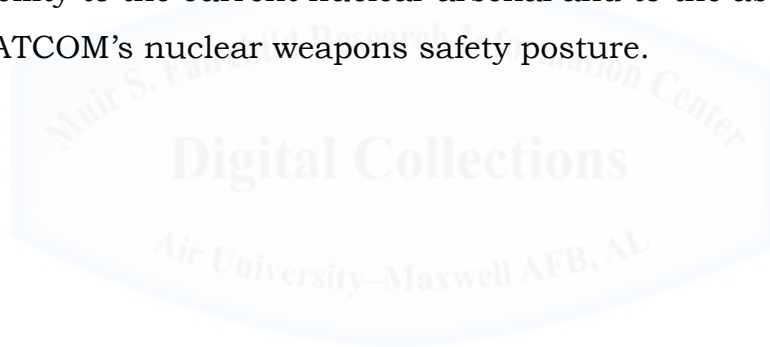
⁵⁷ United States Strategic Command, "Task Forces," http://www.stratcom.mil/task_forces/; United States Strategic Command, "Mission Briefing," ver. 09-10.

⁵⁸ United States Strategic Command, "JFCC-GS Fact Sheet," [http://www.stratcom.mil/factsheets/JFCC - Global Strike/](http://www.stratcom.mil/factsheets/JFCC_-_Global_Strike/); United States Strategic Command, "Task Forces," http://www.stratcom.mil/task_forces/; United States Strategic Command, "Mission Briefing," (version 11-03, 28 January 2011).

⁵⁹ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 54-55.

⁶⁰ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 54; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11.

Like the Air Force, it seems USSTRATCOM adopted the caretaker approach for the nuclear mission. What impact, if any, did this have on nuclear weapons safety? Did it contribute to the Bent Spear and other incidents that occurred around the same timeframe? More importantly, what actions did USSTRATCOM take in response to these incidents, and did they adequately address the problems? Most importantly, as the DoD focal point for the nuclear deterrence mission, is USSTRATCOM postured to safely conduct the nuclear mission? I address these questions in chapters 3 through 6. Next, however, I cover the methodology for this study by analyzing the two competing schools from organization theory related to safety in industries with hazardous technologies. I examine their views, claims, requirements, and applicability to the current nuclear arsenal and to the assessment of USSTRATCOM's nuclear weapons safety posture.



Chapter 2

Methodology Framework

We've seen what it takes to effect conditions of high reliability...It's damn demanding, is very costly, and takes remarkable dedication.

Todd R. LaPorte

This chapter covers the methodology by which I evaluate whether USSTRATCOM is postured to safely conduct the nuclear mission. None of the previous reports or investigations used established frames of reference from organization theory to assess the problem of how to conduct nuclear operations in the safest possible manner. This study does, and thus should inspire more confidence in its findings.

Two Competing Schools of Thought

There are two competing schools of thought from organization theory regarding safety in industries with hazardous technologies. One, known as the high reliability school, claims appropriate organizational design and management techniques can safely manage extremely hazardous technologies, making serious accidents a very rare occurrence.¹ The other, known as the normal accidents school, claims serious accidents, while possibly rare, are inevitable over time, especially in systems with high degrees of interactive complexity and tight coupling.² Given that hazardous technologies are part of our daily lives, what is the best way to reap the benefits of these technologies without suffering the ill effects of accidents involving such technologies? Which school better applies to the current nuclear arsenal? Additionally, which

¹ Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton, NJ: Princeton University Press, 1993), 14, 48.

² Sagan, *Limits of Safety*, 13, 28, 32.

school provides a better approach to ensuring the safety of the nuclear arsenal, and what are the requirements associated with this approach? Finally, what insights from the two schools apply to determining whether USSTRATCOM is postured to safely conduct the nuclear mission?

Here I analyze the two competing schools in detail by examining their claims and requirements. I also cover how I will apply the tenets of the two schools to help determine whether USSTRATCOM is postured to safely conduct the nuclear mission. As with other hazardous technologies, one accident involving nuclear weapons, especially those resulting in an accidental or unauthorized nuclear detonation or nuclear war, would be one too many. Is luck the best explanation for why such an incident has not occurred? According to the normal accidents school, the answer to that question is yes.³

The normal accidents school cites two structural characteristics as the basis for its pessimism regarding safety in organizations with hazardous technologies. The first is high interactive complexity, which produces unpredictable failures, and the second is tight coupling, which rapidly escalates failures out of control.⁴ If these two structural characteristics combine in the same system, this school claims they will surely lead to serious accidents, while the high reliability school claims they are manageable and need not lead to serious accidents.⁵

Interactive complexity is a measure of how the parts of a system are connected and how they interact, characterized by unfamiliar and/or unplanned and unexpected sequences, which are either invisible or not immediately comprehensible.⁶ The opposite is a linear system such as an automobile assembly line.⁷ Organizations or systems with high degrees of interactive complexity are highly vulnerable to common-mode

³ Sagan, *Limits of Safety*, 267-68.

⁴ Sagan, *Limits of Safety*, 44.

⁵ Sagan, *Limits of Safety*, 14, 36, 45-47.

⁶ Sagan, *Limits of Safety*, 32.

⁷ Sagan, *Limits of Safety*, 32.

failures—those involving the failure of a common feature shared by critical components, which causes them all to break down.⁸

Tight coupling, on the other hand, restricts the response time available before small system failures escalate into much larger ones.⁹ Several characteristics distinguish tightly coupled from loosely coupled systems. Tightly coupled systems have numerous time-dependent processes and require continuous production, but in loosely coupled systems, production is slower and can stop if needed without damaging the system.¹⁰ Additionally, in contrast to loosely coupled systems where there are often many ways to produce the product, tightly coupled systems have invariant and sequential production processes.¹¹ Also, tightly coupled systems require highly precise production with little or no slack, while loosely coupled systems require much less precision and allow for repetition of production steps.¹² Finally, unlike loosely coupled systems that allow for successfully improvised responses to individual failures, adequate safety devices and redundancies in tightly coupled systems are mainly limited to those deliberately built into the system.¹³ Universities exemplify loosely coupled organizations, while nuclear power plants exemplify tightly coupled organizations, though both possess high degrees of interactive complexity.¹⁴

Differing Views of Organizations

In addition to the fundamental difference over the effects of interactive complexity and tight coupling, the two schools have fundamentally different views of organizations. Human beings are obviously imperfect, mistake-prone creatures. The high reliability school

⁸ Sagan, *Limits of Safety*, 33.

⁹ Sagan, *Limits of Safety*, 34.

¹⁰ Sagan, *Limits of Safety*, 34.

¹¹ Sagan, *Limits of Safety*, 34.

¹² Sagan, *Limits of Safety*, 34.

¹³ Sagan, *Limits of Safety*, 34.

¹⁴ Sagan, *Limits of Safety*, 35.

contends that through proper design and management, organizations can overcome such human frailties and become more rational and effective than the individuals in them could become.¹⁵ It therefore tends to view high reliability organizations as closed, rational systems.¹⁶ They are *rational* to the degree they exhibit highly formalized structures and orientation toward consistent, common goals, such as safe operations.¹⁷ They are *closed* to the degree they can insulate themselves from other actors and the outside environment in the accomplishment of their goals.¹⁸ In short, the high reliability school holds a predominantly deterministic view of organizations as unitary actors who can chart their own courses.

The normal accidents school holds an opposing view of organizations. It begins with the assumption that organizations are more complicated than the rational actor view implies, often characterized by internal conflict and political motives manifested both internally and externally.¹⁹ It therefore adopts the natural, open systems view of organizations.²⁰ They are *natural* to the extent they are self-interested, like all social groups, and actively pursue goals such as survival and security in addition to other official goals.²¹ They are *open* to the extent they interact with the outside environment, both influencing and being influenced by external forces.²² In short, the normal accidents school holds a predominantly socially constructed view of organizations as self-interested actors, often with conflicting goals, internal conflict, and a complex interplay with their environments.

¹⁵ Sagan, *Limits of Safety*, 16.

¹⁶ Sagan, *Limits of Safety*, 16-17.

¹⁷ Sagan, *Limits of Safety*, 17.

¹⁸ Sagan, *Limits of Safety*, 17.

¹⁹ Sagan, *Limits of Safety*, 28.

²⁰ Sagan, *Limits of Safety*, 29.

²¹ Sagan, *Limits of Safety*, 29.

²² Sagan, *Limits of Safety*, 29.

Though each view has some value in describing modern military nuclear organizations, such organizations are neither completely closed, rational systems nor natural, open systems. These two views are on opposite ends of a spectrum. Such organizations are actually somewhere between these two opposing views. USSTRATCOM certainly seems somewhat natural and/or open given their mission growth, either pursued for self-interested reasons to remain relevant in the post-Cold War environment or imposed by outside forces or some combination of both.

Other military nuclear organizations, such as the Navy's nuclear operations and sustainment organizations and the Air Force's ICBM force under Twentieth Air Force, seem more rational and closed given their continuity and mission focus from the Cold War to today.²³ As noted below in table 1, both the high reliability and normal accidents schools agree that the ideal military model, characterized by isolation from society, intense socialization, and strict discipline, can enhance safety by fostering a culture of reliability.²⁴ No military organization perfectly matches the ideal military model, but those like the Navy's ballistic missile submarine units come close. In this regard, a clear mission and corresponding focus that permeates the entire organization seem critical.

Differing Approaches to Maximize Safety

The two competing schools also have very different views about the best way to maximize safety in industries with hazardous technologies. Again, the high reliability school claims appropriate organizational design and management techniques can safely manage extremely hazardous

²³ Defense Science Board Task Force on Nuclear Weapons Surety, *Report on the Unauthorized Movement of Nuclear Weapons* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, April 2008), 9-10; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase II Report: Review of the DoD Nuclear Mission* (Arlington, VA: December 2008), 39.

²⁴ Sagan, *Limits of Safety*, 50.

technologies, making serious accidents a very rare occurrence.²⁵ It has identified the following four critical causal factors that are necessary for extremely reliable and safe operations: safety as a top leadership priority for both political and organizational leaders, high levels of redundant safety measures, a high reliability culture developed through decentralized decision-making and continually practiced operations, and sophisticated forms of trial and error organizational learning.²⁶ The high reliability school argues that organizations or systems possessing these four factors have the necessary and sufficient ones to avoid serious incidents.²⁷

Meanwhile, the normal accidents school claims serious accidents are inevitable over time, especially in systems with high degrees of interactive complexity and tight coupling.²⁸ Therefore, it contends the best way to maximize safety is to avoid the combination of high interactive complexity and tight coupling.²⁹ Furthermore, it argues the four factors cited by the high reliability school cannot overcome the structural effects of high interactive complexity and tight coupling, and might even be counterproductive.³⁰ For example, the normal accidents school claims safety can only be one of a number of competing organizational and leadership priorities.³¹ It claims redundancy can increase complexity and opaqueness and encourage operators to take more risks.³²

In addition, the normal accidents school finds other shortcomings with the high reliability school's approach. It claims tight coupling's requirement for centralized control to produce rapid responses in

²⁵ Sagan, *Limits of Safety*, 14.

²⁶ Sagan, *Limits of Safety*, 17.

²⁷ Sagan, *Limits of Safety*, 27-28.

²⁸ Sagan, *Limits of Safety*, 13, 28, 32.

²⁹ Sagan, *Limits of Safety*, 275.

³⁰ Sagan, *Limits of Safety*, 44.

³¹ Sagan, *Limits of Safety*, 44.

³² Sagan, *Limits of Safety*, 44.

accordance with standard operating procedures neutralizes decentralized decision-making's benefits.³³ Also, it points out the difficulty of forging a strong organizational culture in an individualistic, democratic society, and the fact that many unpredictable scenarios will not be practiced because they are unforeseen or are simply too dangerous.³⁴ Finally, the normal accidents school claims biased reconstruction, flawed analysis, cover-ups and fabrication, and organizational secrecy mitigate the value of trial and error learning.³⁵

However, the two schools are not completely at odds with one another. For instance, both agree that safety drops significantly when leaders do not have strong incentives to improve safety, although the normal accidents school claims the inevitable existence of conflicting priorities precludes assuming the opposite.³⁶ In addition, both agree that if truly independent, redundancy can improve safety, although the normal accidents school says this is usually not the case in reality.³⁷ As previously noted, both schools agree that the ideal organizational military model can enhance reliability and safety by fostering a culture of reliability.³⁸ In fact, the main disagreement between the two schools is over the degree to which one could or should apply the military model to civilian hazardous technology organizations in a democracy.³⁹ Finally, although both agree in principle that continuous operations and training can help improve safety, the normal accidents school claims the factors noted above mitigate the benefits.⁴⁰ Table 1 presents the differing perspectives of the two schools along with cases of overlap or agreement.

³³ Sagan, *Limits of Safety*, 44.

³⁴ Sagan, *Limits of Safety*, 41.

³⁵ Sagan, *Limits of Safety*, 41-43.

³⁶ Sagan, *Limits of Safety*, 255.

³⁷ Sagan, *Limits of Safety*, 39.

³⁸ Sagan, *Limits of Safety*, 50.

³⁹ Sagan, *Limits of Safety*, 41, 50.

⁴⁰ Sagan, *Limits of Safety*, 41.

Table 1: Competing Perspectives on Safety with Hazardous Technologies

<i>High Reliability School</i>	<i>Normal Accidents School</i>	<i>Areas of Overlap or Agreement</i>
Main Argument: Accidents can be prevented good organizational design and management.	Main Argument: Accidents are inevitable in complex and tightly coupled systems.	
Safety is the priority organizational objective.	Safety is one of a number of competing objectives.	Safety drops significantly when leaders do not have strong incentives to improve safety.
Redundancy enhances safety: duplication and overlap can make “a reliable system out of unreliable parts.”	Redundancy often causes accidents: it increases interactive complexity and opaqueness and encourages risk-taking.	If truly independent, redundancy can improve safety.
Decentralized decision-making needed to permit prompt and flexible field-level responses to surprises.	Organizational contradiction: decentralization needed for complexity, but centralization needed for tightly coupled systems.	
A “culture of reliability” will enhance safety by encouraging uniform and appropriate responses by field-level operators.	A military model of intense discipline, socialization, and isolation is incompatible with democratic values.	Ideal military model— isolation from society, intense socialization, and strict discipline— can enhance reliability and safety.
Continuous operations, training, and simulations can create and maintain high reliability operations.	Organizations cannot train for unimagined, highly dangerous, or politically unpalatable operations.	Agree in principle that continuous operations and training can help improve safety.
Trial and error learning from accidents can be effective and enhanced by anticipation and simulations.	Denial of responsibility, faulty reporting, and reconstruction of history cripples learning efforts.	

Source: Modified version of Table 1.1 from Scott D. Sagan’s The Limits of Safety

Better Fit to Current Arsenal

In his 1993 book titled, *The Limits of Safety*, Scott D. Sagan analyzed several case studies from the Cold War period to determine if the high reliability school or the normal accidents school better explained the safety record of the nuclear arsenal and C2 system, which exhibited high degrees of interactive complexity and tight coupling.⁴¹ He expected to find that the high reliability school offered the better explanation, but concluded instead that the normal accidents school's rationale better fit the actual circumstances of the numerous close calls he discovered studying nuclear weapons incidents.⁴² Accordingly, he argued that changing the structure of the nuclear arsenal to avoid the combination of interactive complexity and tight coupling was the best approach to maximize safety.⁴³ Are his findings still supported by the structure of the current arsenal and the circumstances surrounding the 2007 Minot AFB Bent Spear—the only significant nuclear weapons incident since USSTRATCOM's inception?⁴⁴

There is reason to believe that changing the structure as Sagan suggested may not yield the expected positive effect on safety. In fact, the bomber leg of the nuclear triad, the only leg in which the structure changed, suffered the greatest decline in safety as evidenced by the 2007 Bent Spear. The change occurred in September 1991 when President George H. W. Bush took the bombers off alert.⁴⁵ This action physically removed the nuclear warheads from the bomber force on a day-to-day basis, thus eliminating tight coupling as a structural characteristic. Ironically, Sagan considered this action a positive safety measure, but several reports cited it as a causal factor of the Bent Spear due to the

⁴¹ Sagan, *Limits of Safety*, 48-49.

⁴² Sagan, *Limits of Safety*, 250, 252, 267.

⁴³ Sagan, *Limits of Safety*, 275.

⁴⁴ Larry Chandler, DTRA contractor, to the author, e-mail, 10 March 2011; Air Force Policy Directive (AFPD) 91-1, *Safety: Nuclear Weapons and Systems Surety*, 13 February 2007, 3.

⁴⁵ Lawrence Freedman, *The Evolution of Nuclear Strategy*, 3rd ed. (New York: Palgrave Macmillan, 2003), 422-23.

pattern of neglect and lack of focus on the nuclear mission that ensued.⁴⁶

Though reduced in numbers, the current structure of U.S. nuclear forces, as reflected in the alert posture and triad, is the same as in 1993 when *The Limits of Safety* was published—bombers off day-to-day alert, ICBMs on alert, and a significant number of SLBMs at sea on ballistic missile submarines at any given time.⁴⁷ The 2010 Nuclear Posture Review effectively ruled out Sagan's recommendation to change the structure further, based on the decision to retain the current alert posture indefinitely and the nuclear triad for at least ten years.⁴⁸ The fact that the ICBM and SLBM legs of the triad will retain their interactive complexity and tight coupling characteristics indefinitely and that safety actually worsened after changing the bomber leg's structure, suggest the high reliability school may provide a more useful and realistic approach to maximize safety.

Additionally, the continued fact that no accidental or unauthorized nuclear detonations or accidental nuclear wars occurred in the 18 years since Sagan published his findings further undermines his and the normal accidents school's claims.⁴⁹ The inevitable did not occur and luck still did not run out. These did not occur despite the problems noted in the U.S. arsenal and concerns about proliferation and loose nuclear material.⁵⁰ Top national security documents reflect these concerns by giving a top priority to reversing the spread of nuclear

⁴⁶ Sagan, *Limits of Safety*, 9; Senate, *Air Force Nuclear Security: Hearing before the Committee on Armed Services*, 110th Cong., 2d sess., 12 February 2008, 8; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11-13, 15; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase I Report: The Air Force's Nuclear Mission* (Arlington, VA: September 2008), 22-23, 52-53.

⁴⁷ Department of Defense, *Nuclear Posture Review Report* (Washington, DC: April 2010), 27.

⁴⁸ Department of Defense, *Nuclear Posture Review Report*, ix-x, 19-27.

⁴⁹ Sagan, *Limits of Safety*, 267-68.

⁵⁰ Sagan, *Limits of Safety*, 266-68.

weapons and by citing nuclear terrorism as the number one threat.⁵¹ None of this suggests Sagan's findings are without merit. It does suggest that maximizing nuclear weapons safety is not as easy as simply removing the combination of high interactive complexity and tight coupling.

Methodology

This study uses Sagan's *The Limits of Safety* as a starting point but does not duplicate its methodology. Sagan analyzed various case studies from throughout the Cold War to determine which school better fit the nuclear arsenal and C2 system's safety record.⁵² Unlike Sagan, I do not attempt to analyze a large number of case studies. Instead, I primarily analyze the factors involved in the Bent Spear to determine whether USSTRATCOM is postured to safely conduct the nuclear mission.⁵³

I do so through a four-step process employed in chapters 3 through 6. First, in each chapter I provide an overview of the high reliability school's claims for one of the four major interrelated factors the school considers necessary to make accidents in industries with hazardous technologies extremely rare. Second, I cover the counterclaims made by the normal accidents school about the factor along with any areas of overlap or agreement. Third, I analyze USSTRATCOM's safety posture in relation to the factor around the time of the Bent Spear. I do so first from the high reliability school's perspective, then from the normal accidents school's perspective, and finally in relation to any area of agreement between the two schools. Finally, for each factor, I examine relevant actions taken by USSTRATCOM in response to the Bent Spear and assess their impact on its safety posture. The purpose of this process is to identify any

⁵¹ President, *National Security Strategy* (Washington, DC: May 2010), 1, 3-4, 8, 17, 20, 23; Department of Defense, *Nuclear Posture Review Report*, iv-vii, 9-13.

⁵² Sagan, *Limits of Safety*, 48-49.

⁵³ Chandler to the author, e-mail; AFD 91-1, *Safety*, 3.

problems at USSTRATCOM that possibly contributed to the Bent Spear, to evaluate whether the problems persist or not, and to assess whether USSTRATCOM is currently postured to safely conduct the nuclear mission. Additional clarity about which school provides the better approach to ensuring the safety of the nuclear arsenal and the requirements associated with this approach should also result. Next, chapter 3 begins the process by examining whether safety is a top leadership priority at USSTRATCOM.



Chapter 3

Safety as a Top Leadership Priority

The man in charge must concern himself with details. If he does not consider them important, neither will his subordinates...it is hard and monotonous to pay attention to seemingly minor matters...but when the details are ignored, the project fails.

Adm Hyman G. Rickover

Before nuclear weapons safety can be a top organizational priority, the nuclear mission itself must be the organization's top priority, and its leaders must be free to focus on the nuclear mission. This chapter's purpose is to evaluate whether nuclear weapons safety was a top leadership priority at USSTRATCOM around the time of the 30 August 2007 Minot Bent Spear and how much improvement has been made in this area since that time. The chapter begins with a synopsis of the Bent Spear for reference throughout the remainder of this study. Then, I provide an overview of the high reliability school's claims about the importance of safety as a top leadership priority. Next, I cover the counterclaims made by the normal accidents school, along with an area of agreement between the two schools about safety as a top leadership priority. These two sections summarize the material about this factor in Sagan's *The Limits of Safety*. Then, I evaluate whether safety was a top leadership priority at USSTRATCOM around the time of the Bent Spear—first from the high reliability school's perspective, then from the normal accidents school's perspective, and finally in relation to the area of agreement between the two schools. Finally, I review pertinent corrective actions taken by USSTRATCOM in response to the Bent Spear and

assess their impact on its safety posture. Due to the interrelated nature of the four high reliability school factors, there is some overlap between the information presented here and in subsequent chapters.

Synopsis of 30 August 2007 Minot Bent Spear

The 30 August 2007 unauthorized transfer of nuclear weapons from Minot AFB to Barksdale AFB—categorized as a Bent Spear in nuclear safety terms for significant incidents—is the only serious nuclear weapons incident to date in USSTRATCOM’s history.¹ It occurred as part of an Advanced Cruise Missile (ACM) repositioning program, which supported the decommissioning aspects of the Strategic Offensive Reductions Treaty, also known as the Moscow Treaty.² Air Combat Command, the Air Force major command with the nuclear bomber mission at the time, ordered Minot’s 5th Bomb Wing and Barksdale’s 2nd Bomb Wing to support the ACM repositioning program via B-52 *tactical ferry* missions.³

These missions were supposed to transport only nuclear-inert ACMs—those with W80-1 nuclear warheads removed—from Minot AFB to Barksdale AFB.⁴ The normal configuration for ACMs is six missiles

¹ Air Force Policy Directive (AFPD) 91-1, *Safety: Nuclear Weapons and Systems Surety*, 13 February 2007, 3; Larry Chandler, DTRA contractor, to the author, e-mail, 10 March 2011.

² Department of Defense Inspector General, *Oversight of the Investigation Directed by the Commander, Air Combat Command Concerning an Unauthorized Transfer of Classified Material from Minot Air Force Base, North Dakota to Barksdale Air Force Base, Louisiana on August 30, 2007*, (Washington, DC: 8 February 2008), 2, 4, in Senate, *Air Force Nuclear Security: Hearing before the Committee on Armed Services*, 110th Cong., 2d sess., 12 February 2008, 32, 34. The Moscow Treaty was superseded by New START—see “Treaty Between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms,” 8 April 2010, 16; and Department of State, *Fact Sheet: New START Treaty Entry Into Force* (Washington, DC: Office of the Spokesman, 5 February 2011), 1.

³ DoD IG, *Oversight of the Investigation*, 2, in Senate, *Air Force Nuclear Security*, 32. AFGSC assumed responsibility for the Air Force’s nuclear-capable bombers on 1 February 2010—see Air Combat Command Public Affairs, “ACC Transfers Bombers to AFGSC Feb. 1,” *Air Force Print News*, 1 February 2010, http://www.acc.af.mil/news/story_print.asp?id=123188454.

⁴ Defense Science Board Task Force on Nuclear Weapons Surety, *Report on the Unauthorized Movement of Nuclear Weapons* (Washington, DC: Office of the Under

mounted on a pylon, with one pylon mounted under each wing of the B-52.⁵ The 30 August 2007 mission was the sixth of 12 planned tactical ferry missions.⁶ The figure below reflects the approved process and procedures in effect at the time of the Bent Spear for all nuclear-capable ACM movements and handling, from storage facility access to completed loading on the ferry aircraft.⁷

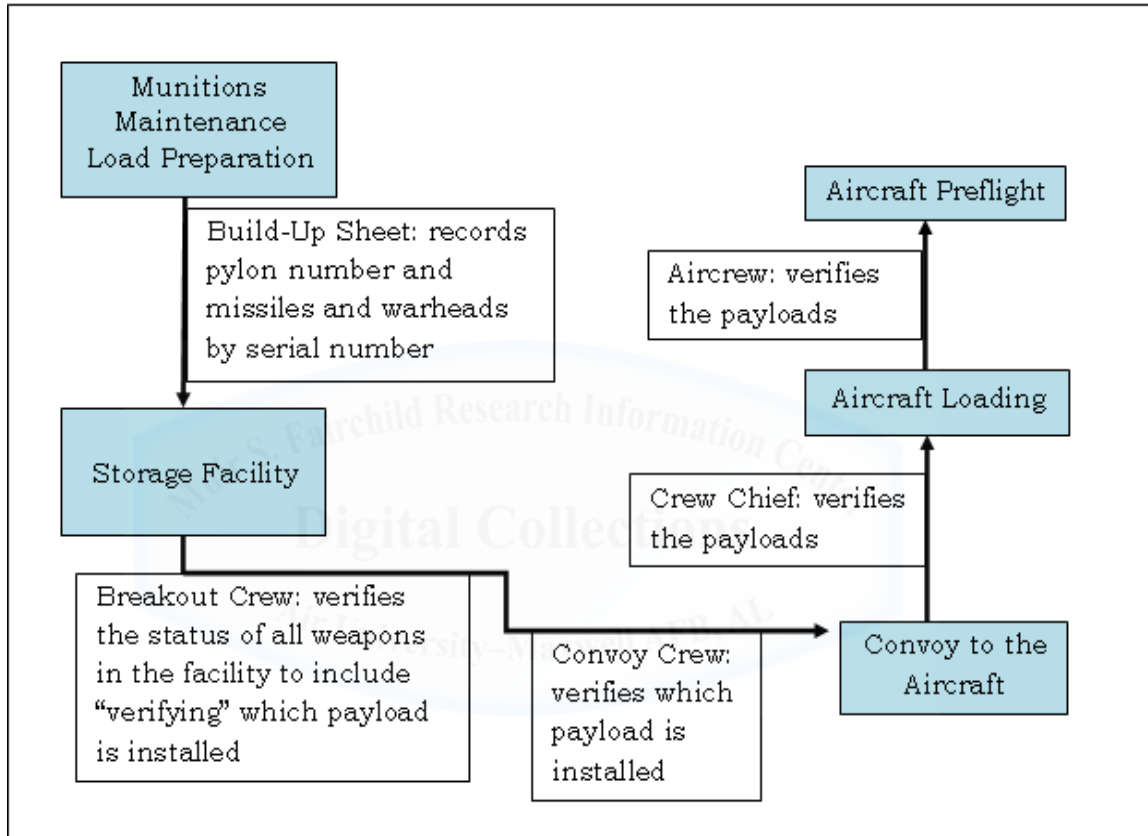


Figure 2: Process and Procedure for B-52 ACM Movement Flow

Source: Figure 1 from DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*

Secretary of Defense for Acquisition, Technology, and Logistics, April 2008), 2; DoD IG, *Oversight of the Investigation*, 2, in Senate, *Air Force Nuclear Security*, 32; Senate, *Air Force Nuclear Security*, 20. DoD normally transports nuclear warheads by air inside C-17 or C-130 cargo aircraft—see Michael Hoffman, “Officials Red-faced Over Nuke Error – Congress Seeks Explanation of How B-52 Carried Warheads,” *Air Force Times*, 17 September 2007.

⁵ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 2.

⁶ DoD IG, *Oversight of the Investigation*, 4, in Senate, *Air Force Nuclear Security*, 34.

⁷ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 2.

The first step in the process was to prepare the scheduled ACMs for tactical ferry by removing the nuclear warheads to make the ACMs inert.⁸ After this, the maintenance team taped a placard to the inert ACMs, identifying them as a tactical ferry load.⁹ At the storage facility, the munitions handling team placed orange cones around these ACM pylons to differentiate them further from other types of ACMs.¹⁰ At the time, Air Force guidance allowed storage of all ACMs—nuclear training, test, inert, and nuclear armed—in the same facility.¹¹

When the time came to execute the scheduled tactical ferry mission, the process began with the breakout crew. Procedures required them to open the storage facility and verify the payload and safety status of every weapon in it by visually checking each missile through an external inspection port before any other activities occur.¹² The next step involved another verification of the payloads by the convoy crew before they towed the pylon trailer to the aircraft.¹³ The third step occurred at the aircraft where the crew chief accepted the load after verifying the payloads.¹⁴ The load crew then loaded the pylon onto the aircraft and checked each missile's status.¹⁵ The final step before preflight and takeoff had the aircrew accomplish its own payload and safety status check for each missile before accepting the load.¹⁶

⁸ DoD IG, *Oversight of the Investigation*, 4, in Senate, *Air Force Nuclear Security*, 34.

⁹ DoD IG, *Oversight of the Investigation*, 4, in Senate, *Air Force Nuclear Security*, 34.

¹⁰ DoD IG, *Oversight of the Investigation*, 4-5, in Senate, *Air Force Nuclear Security*, 34-35.

¹¹ DoD IG, *Oversight of the Investigation*, 5, in Senate, *Air Force Nuclear Security*, 35; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 2. This guidance was subsequently changed to preclude mixing nuclear and non-nuclear missiles in the same storage facility—see Michael Hoffman, “Warhead Mishap Drives Change in Nuclear Handling Procedures,” *Air Force Times*, 11 February 2008.

¹² DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 2, 5; Senate, *Air Force Nuclear Security*, 18.

¹³ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

¹⁴ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

¹⁵ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

¹⁶ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

For the 30 August 2007 tactical ferry mission, the movement plan identified two pylons of nuclear-inert missiles for transport from Minot AFB to Barksdale AFB on board a 2nd Bomb Wing B-52H.¹⁷ Members of Minot's 5th Munitions Maintenance Squadron modified the plan by replacing one of the pylons with one that had missiles with limited life components closer to their expiration dates.¹⁸ The movement plan reflected this change, but the informal documents used internally at Minot for daily operations did not.¹⁹ The two pylons prepared for tactical ferry reflected the change to the movement plan, which meant one of the originally scheduled pylons still had its nuclear warheads in the ACMs.²⁰

The breakout crew, working from internal documents, failed to verify the status of the weapons in the storage facility as required, and therefore failed to note that one of the pylons on their paperwork still contained ACMs with nuclear warheads.²¹ The convoy crew, crew chief, and aircrew all repeated the breakout crew's error by not verifying the ACM payloads.²² The aircrew then flew the nuclear-armed ACMs to Barksdale AFB, where the local convoy crew discovered the error.²³ It took over 36 hours to catch the error from the time the six W80-1 nuclear weapons left the storage facility.²⁴ The weapons did not have proper security during that time.²⁵

Before I evaluate whether safety was a top leadership priority at USSTRATCOM around the time of the Bent Spear, it is important to understand the differing perspectives of the two competing schools

¹⁷ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 2-3.

¹⁸ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

¹⁹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

²⁰ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

²¹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

²² DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

²³ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

²⁴ Senate, *Air Force Nuclear Security*, 2.

²⁵ Michael Hoffman, "Nuclear Safety Slipped for Years Before Minot," *Air Force Times*, 26 February 2008.

concerning the importance of safety as a top leadership priority in organizations with hazardous technologies. First, I provide an overview of the high reliability school's claims about this factor.

High Reliability School Perspective

The high reliability school asserts that the primary and most obvious requirement for high reliability organizations, including those involved with hazardous technologies, is that organizational and political leaders must regard safety as a top priority.²⁶ In such organizations, the goal of avoiding serious failures altogether is visible to all observers, as seen in the commercial airline industry.²⁷ In addition, the other required factors hinge on this factor to a large degree.

There are two main reasons why it is essential for leaders to regard safety as a top priority. First, high levels of redundancy and continuous training are both necessary and very expensive.²⁸ If leaders are unwilling or unable to provide the considerable resources needed, safety suffers, and the risk of serious accidents increases.²⁹ Second, in order to develop a culture of reliability and safety, leaders must communicate the importance of safe operations clearly and consistently to the entire organization.³⁰ Such communication helps ensure all members of the organization understand that safety is an integral part of the organization's mission.³¹

Normal Accidents School Perspective and Agreement

The normal accidents school admits that high leadership priority on safety can prove beneficial, but it claims the structural factors of high

²⁶ Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton, NJ: Princeton University Press, 1993), 17. Chapters 3 through 6 rely heavily on Sagan's description of the two schools' claims to form the basis for the analytical framework used in this study's assessment of USSTRATCOM's safety posture.

²⁷ Sagan, *Limits of Safety*, 17-18.

²⁸ Sagan, *Limits of Safety*, 18.

²⁹ Sagan, *Limits of Safety*, 18.

³⁰ Sagan, *Limits of Safety*, 19.

³¹ Sagan, *Limits of Safety*, 19.

interactive complexity and tight coupling override most of the beneficial effects from this factor.³² Also, based on its view of organizations, it claims conflict over organizational goals will persist, even when safety is recognized as the avowed leadership priority.³³

Continuing conflict over goals usually appears in three major ways.³⁴ First, despite the call for increased safety, the competing need to maintain production can counteract efforts to turn this call into reality.³⁵ The classic signs of production pressure are “hasty decision-making, violations of safety rules, and jerry-rigged procedures.”³⁶ The school cites the Space Shuttle *Challenger* disaster in 1986 as a prime example of this phenomenon.³⁷

Second, if the call for increased safety comes from external leaders, the organization’s own goals may conflict with making safety a top priority and can help thwart such an effort.³⁸ The school points out problems in monitoring hazardous-technology organizations by government agencies.³⁹

Finally, even if external and internal leaders agree on the need to make safety a high priority, organizational subordinates can frustrate the effort by concealing the extent of safety problems through underreporting and other techniques.⁴⁰ Even rewarding employees with top safety records can inadvertently incentivize information withholding.⁴¹

³² Sagan, *Limits of Safety*, 37.

³³ Sagan, *Limits of Safety*, 37. Please recall from chapter 2 that the high reliability school tends to view high reliability organizations as closed, rational systems, while the normal accidents school adopts the natural, open systems view of organizations.

³⁴ Sagan, *Limits of Safety*, 37.

³⁵ Sagan, *Limits of Safety*, 37.

³⁶ Sagan, *Limits of Safety*, 37.

³⁷ Sagan, *Limits of Safety*, 38.

³⁸ Sagan, *Limits of Safety*, 38.

³⁹ Sagan, *Limits of Safety*, 38.

⁴⁰ Sagan, *Limits of Safety*, 38.

⁴¹ Sagan, *Limits of Safety*, 38.

Although the two schools disagree about the likely benefits from leaders making safety a top priority, they agree that safety drops significantly when leaders do not have strong incentives to improve safety.⁴² The recognized incentives to improve safety stem from the personal interest a leader might have as a potential victim of the hazardous technology.⁴³

For instance, Charles Perrow of the normal accidents school emphasized that elites who fly frequently have a vested interest in airline safety, and high-ranking Navy officers serving on carriers have the same personal interest in safe carrier operations.⁴⁴ He contrasted this situation with nuclear power plants and freighters loaded with hazardous cargos, where elites physically spend little to no time, thus decreasing their personal interest in the safety of these industries.⁴⁵

Bent Spear and Priority of Safety at USSTRATCOM

Having covered the differing perspectives of the two competing schools, as well as their area of agreement, I now evaluate whether safety was a top leadership priority at USSTRATCOM around the time of the Bent Spear. My evaluation proceeds from the lens of the high reliability school to the normal accidents school to the area of agreement between the two schools.

High Reliability School

Accurately gauging whether the goal of avoiding serious failures was visible to all observers at the time of the Bent Spear is difficult. In one sense, the easy answer is yes, because obviously no leader ever said, “it is OK now to have serious nuclear weapons failures.” Indeed, the long-held *zero-defects* standard for nuclear weapons safety, security, and reliability continued despite the end of the Cold War and will likely

⁴² Sagan, *Limits of Safety*, 255.

⁴³ Sagan, *Limits of Safety*, 37.

⁴⁴ Sagan, *Limits of Safety*, 37.

⁴⁵ Sagan, *Limits of Safety*, 37.

continue for as long as the United States has nuclear weapons.⁴⁶ Nevertheless, it is probably safe to say that emphasis and attention devoted to this goal suffered alongside the perceived devaluing of the nuclear mission more broadly, throughout the period leading up to the Bent Spear.⁴⁷

One way of gauging whether nuclear weapons safety was a visible top priority at USSTRATCOM is to examine the rank of those within USSTRATCOM who were responsible for the nuclear mission. For example, the highest-ranking officer with undivided daily focus on the nuclear mission went from the four-star commander in 2002 to an Air Force lieutenant colonel in a colonel's billet by late 2007.⁴⁸ Also, after not having a major, end-to-end nuclear exercise for over a decade, the senior USSTRATCOM representative for the June 2009 Global Thunder exercise planning conferences was a lieutenant colonel.⁴⁹ Finally, the JFCC-GS commander was a two-star general officer, while the other military functional component commanders were three-star general officers.⁵⁰

A second way to determine if safety was a top priority is to assess the amount of redundancy employed and resources for continuous

⁴⁶ Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase I Report: The Air Force's Nuclear Mission* (Arlington, VA: September 2008), 13; Sagan, *Limits of Safety*, 278-79; See also paragraph 4.2.1., DOD Directive (DODD) 3150.2, *DOD Nuclear Weapons System Safety Program*, 23 December 1996, 2.

⁴⁷ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 15-19; Defense Science Board Task Force on Nuclear Deterrence Skills, *Report* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, September 2008), vi-vii, 15, 59.

⁴⁸ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 13; Michael G. Vaughn (Contractor, US Strategic Command, Offutt AFB, NE), phone interview by the author, 7 April 2011—Col Vaughn, USAF, retired, was STRAT/J38 (Chief, Nuclear Operations and C2 Division) from June 2008-December 2010.

⁴⁹ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35, C-4; DSB Task Force on Nuclear Deterrence Skills, *Report*, 37; Gen Kevin P. Chilton, commander, US Strategic Command (address, Air Force Association Convention, Orlando, FL, 26 February 2009).

⁵⁰ United States Strategic Command, "Mission Briefing," version 09-10, (address, Air Command and Staff College, Maxwell AFB, AL, 21 August 2009).

training. First, in terms of redundancy regarding the Bent Spear, there was too much reliance on redundant personnel verifications of the ACM payloads. Responsible leaders overlooked other possible redundant measures. For instance, there is no evidence of the use of technical redundancy to augment the personnel redundancy, perhaps due to lack of funding—see chapter 4.

Second, as far as training in the bomber leg, the conventional mission dominated over nuclear mission preparation to such an extent that only the restricted area, where nuclear weapons are maintained and stored, saw daily attention on the nuclear mission.⁵¹ Additionally, neither the B-52 initial training, nor the advanced weapons school courses had flying sorties devoted to the nuclear mission.⁵² Instead, each course only included a single simulator mission focused on this mission.⁵³ By 2007, most bomber personnel had never experienced nuclear alert, and though most of the B-52s were at Barksdale AFB, the base did not have its own nuclear weapons storage area.⁵⁴ Consequently, B-52 aircrews and weapons handlers estimated they spent only about 5 to 20 percent of their time on the nuclear mission.⁵⁵

Meanwhile, the mission growth at USSTRATCOM took its toll on the command's ability to remain focused on the nuclear mission and nuclear safety.⁵⁶ In addition to the reduced rank of those responsible for the nuclear mission, at the headquarters the number of people working nuclear issues decreased by roughly half from a little over 600 to just

⁵¹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12-13.

⁵² DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12-13.

⁵³ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁵⁴ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12; DSB Task Force on Nuclear Deterrence Skills, *Report*, 38; Air Force Association, "No Weapons Storage Area for Barksdale," AirForce-Magazine.com, 23 February 2011, <http://www.airforce-magazine.com/DRArchive/Pages/2011/February%202011/February%2023%202011/NoWeaponsStorageAreaforBarksdale.aspx>.

⁵⁵ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11.

⁵⁶ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11, 13.

over 300 between 2002 and 2007.⁵⁷ In terms of missions to resource and for which to advocate, the nuclear mission went from the only one, to one of eight global missions.⁵⁸ Therefore, in terms of resources, the Air Force's caretaker approach to the nuclear mission went uncontested, in part because USSTRATCOM had adopted the same approach due to mission growth and a corresponding loss of focus on the nuclear mission at the headquarters.⁵⁹

In addition, USSTRATCOM leaders did not successfully communicate the importance of the nuclear mission and weapons safety to all USSTRATCOM members. The strongest evidence comes from the operator or technician level, as indicated by responses to a February 2008 survey from members of nuclear deterrence organizations.⁶⁰ The respondents rated their organization's effectiveness in focusing on the mission and setting policies that support mission performance as only average.⁶¹

More telling than survey responses, the actions of some operators and technicians provided ample evidence of a lack of regard for weapons safety and inadequate appreciation of safety's importance to the mission. Of course, those who helped cause the Bent Spear by not verifying the ACM payloads showed this lack of regard and appreciation of safety's importance, in addition to a lack of attention to detail and checklist discipline.⁶² Coming on the heels of the Bent Spear, an egregious example of a lack of regard for nuclear weapons safety and security

⁵⁷ DSB Task Force on Nuclear Deterrence Skills, *Report*, 55.

⁵⁸ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase II Report: Review of the DoD Nuclear Mission* (Arlington, VA: December 2008), 53.

⁵⁹ Department of the Air Force, *Reinvigorating the Air Force Nuclear Enterprise* (Washington, DC: Air Force Nuclear Task Force, 24 October 2008), 1; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 55.

⁶⁰ DSB Task Force on Nuclear Deterrence Skills, *Report*, 77, 79-80, 99-100.

⁶¹ DSB Task Force on Nuclear Deterrence Skills, *Report*, 77, 79-80, 99-100.

⁶² DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3, 5.

occurred in May 2008 during the 5th Bomb Wing's nuclear surety inspection (NSI). A security forces Airman chose to play video games on his cell phone during an exercise when his duties required him to guard the restricted area's perimeter.⁶³ The wing went on to fail the inspection, its second failure in a row after the Bent Spear.⁶⁴ Another Airman, questioned during the same NSI exercise, was "unaware of her duties and responsibilities."⁶⁵ Unfortunately, such problems went beyond the bomber leg of the triad.

Similar problems were visible in the ICBM community. The well-known shipment of four ICBM nuclear forward section RV assemblies to Taiwan, discovered in March 2008, began in 2005 with the failure of Airmen at F.E. Warren AFB to mark properly the top-secret classification on the assemblies' shipping containers.⁶⁶ Additionally, in July 2008 three out of four missileers, who had finished a 24-hour alert in an underground launch control center where they changed out code components, fell asleep in the topside support building while waiting for permission to return to Minot AFB with the old code components—another clear violation of procedures. Previously, in May 2008 another Minot missileer admitted to stealing a tamper detection indicator in July 2005 and accused his crew partner at the time of doing the same.⁶⁷ Tamper detection indicators are classified items used to protect installed

⁶³ Michael Hoffman, "5th Bomb Wing Flunks Nuclear Inspection," *Air Force Times*, 30 May 2008.

⁶⁴ Michael Hoffman, "5th Bomb Wing Flunks Nuclear Inspection," *Air Force Times*, 30 May 2008.

⁶⁵ Michael Hoffman, "5th Bomb Wing Flunks Nuclear Inspection," *Air Force Times*, 30 May 2008.

⁶⁶ Department of Defense, *Transcript: DoD News Briefing with Secretary Gates from the Pentagon* (Washington, DC: Office of the Under Secretary of Defense for Public Affairs, 5 June 2008), 1-4; Michael Hoffman, "Nuke Safety Was Issue Long Before Moseley-Wynne Era-But 'Serious, Systemic Problem' May Have Worsened," *Air Force Times*, 16 June 2008.

⁶⁷ James MacPherson, "Supervisor: Capt. Admitted Taking Launch Device," *Air Force Times*, 30 September 2008.

code components by leaving a residue behind if removed.⁶⁸ The officer admitted that instead of destroying the indicator as required, he kept it as a souvenir and signed a false statement claiming he had destroyed the item.⁶⁹

In addition to these problems, the comments of several operators and technicians at multiple levels reveal a lack of appreciation of the nuclear mission's importance and safety's importance along with it. The first example comes from the Defense Science Board's Task Force on Nuclear Weapons Surety report dated April 2008. The task force noted an experienced B-52 aircraft commander's comment: "The nuclear mission is all about procedures; the conventional mission is about operational results."⁷⁰ The task force concluded the bomber force regarded the nuclear mission as merely an exercise activity and not a true operational activity and found this attitude indicative of the prevailing culture in the bomber force.⁷¹ The task force contrasted this attitude with the dominant Cold War attitude, which was highly operational.⁷²

The second example comes from the February 2008 survey mentioned earlier and reflected someone's negative assessment of the prevalent attitude in his/her organization: "People aren't taking the pride in ownership of their job and it affects the mission."⁷³ Finally, the 2008 Task Force on DoD Nuclear Weapons Management noted the prevalent attitude that characterized the morale of Air Force nuclear units: "We know that the president and secretary of defense don't give a

⁶⁸ Derek Kravitz, "Air Force Officer Faces Hearing for Theft," *Washington Post*, 30 September 2008, http://voices.washingtonpost.com/washingtonpostinvestigations/2008/09/air_force_of_ficer_faces_hearin.html.

⁶⁹ James MacPherson, "Supervisor: Capt. Admitted Taking Launch Device," *Air Force Times*, 30 September 2008.

⁷⁰ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁷¹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁷² DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁷³ DSB Task Force on Nuclear Deterrence Skills, *Report*, 105.

damn about what we do.”⁷⁴ These examples revealed the absence of a nuclear stewardship champion within the DoD and the need for USSTRATCOM to assume this role and articulate passionately the nuclear mission’s continued importance to those above and below them.

Normal Accidents School

The normal accidents school’s perspective provides additional insights in assessing whether safety was a top leadership priority at USSTRATCOM around the time of the Bent Spear. From this perspective, the first assessment involves whether high interactive complexity and tight coupling thwarted the beneficial effects of USSTRATCOM placing a high leadership priority on safety.⁷⁵ First, based on the assessment thus far in this chapter, it does not appear that the nuclear mission and nuclear weapons safety were top priorities at USSTRATCOM.

Second, as noted in chapter 2, tight coupling no longer applied as a structural characteristic, although further analysis reveals high interactive complexity did. The 30 August 2007 tactical ferry mission involved complex organizations—B-52 wings from two bases, with maintenance and munitions personnel from Minot working with planes and aircrew from Barksdale—and systems—the B-52s themselves. Therefore, given the tactical ferry mission displayed high interactive complexity but not tight coupling, an unpredictable failure that did not escalate to an out of control accident would conform to the normal accidents school’s view of these characteristics.⁷⁶ However, one could

⁷⁴ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 39.

⁷⁵ Sagan, *Limits of Safety*, 37.

⁷⁶ Sagan, *Limits of Safety*, 44. Even though nuclear weapons were involved in the Bent Spear, tight coupling was not a relevant factor due to the warhead design, which greatly reduced the likelihood of a plutonium release, and the fact the weapons were never armed—for more information, see Senate, *Air Force Nuclear Security*, 71-72.

argue whether such a failure was unpredictable given the context and warnings from various reports for over a decade before the incident.⁷⁷

In addition, the normal accidents school claims conflict over organizational goals persists even when safety is recognized as a top leadership priority.⁷⁸ In most organizations, production pressure is often a source of conflict. In the case of the Bent Spear, some of the signs of production pressure were evident—jerry-rigged procedures and violations of safety rules—perhaps partially due to a desire to comply with the terms of the Moscow Treaty in a timely manner. The most obvious violations of safety rules were the four payload verifications that the various weapons handlers and crews failed to perform.⁷⁹

Various weapons handlers used jerry-rigged procedures or shortcuts. For instance, the breakout crew's initial status verification of all weapons in the storage facility should normally take about 45 minutes, and must precede other actions.⁸⁰ Over time, however, in order to expedite the process the breakout and convoy crews changed the procedure by simultaneously conducting the initial verification and connecting the pylon trailer to the tow vehicle.⁸¹ Additionally, the requirement to distinguish nuclear-inert ACMs involved placing placards on multiple sides of the pylon and orange cones around it.⁸² These steps gradually devolved to placing one 8 x 10 in. piece of paper somewhere on the pylon and no orange cones.⁸³ Finally, the informal documents used internally at Minot for daily operations that conflicted with the formal movement plan exemplify jerry-rigged procedures. However, signs of

⁷⁷ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 6, 15-19.

⁷⁸ Sagan, *Limits of Safety*, 28-29, 255. In fact, due to their view of organizations, the school claims conflict over goals is an inherent quality of organizational life.

⁷⁹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

⁸⁰ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

⁸¹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

⁸² DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

⁸³ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

production pressure do not mean that production pressure was the primary cause of the noted problems, but these indicators do imply that it was a possible factor. Alternative explanations include inadequate training, apathy, and/or complacency.

The normal accidents school also claims that calls for increased safety from external leaders could meet resistance from the responsible organization, whose goal of autonomy may lead to conflict and could help thwart such an effort. In case of the Bent Spear, USSTRATCOM neglected its independent oversight responsibility due to a shared lack of interest in the nuclear mission with the Air Force.⁸⁴ Thus, there was no tension over safety between the Air Force and USSTRATCOM. It seems USSTRATCOM unwittingly found itself in a similar position as the negligent supervisors at Minot—“too much trust and no verification.”⁸⁵

The next few paragraphs support this assessment, but for now, the following example speaks volumes. In December 2008, USSTRATCOM established and filled, with Brig Gen Joseph D. Brown IV, a one-star general officer position for nuclear operations (J3N) within its operations directorate.⁸⁶ He made it a point to visit every installation with nuclear forces and discovered that in some cases no senior leader from USSTRATCOM had visited in over 10 years.⁸⁷ The lack of visits helped foster an attitude among those who performed the nuclear mission that no one really cared about what they did.⁸⁸ This example is just one

⁸⁴ Sagan, *Limits of Safety*, 268-69; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7, 9, 11, 13; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53, 55-56, 58; DSB Task Force on Nuclear Deterrence Skills, *Report*, 36-37.

⁸⁵ DoD IG, *Oversight of the Investigation*, 5, in Senate, *Air Force Nuclear Security*, 35.

⁸⁶ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 56; Maj Gen Joseph D. Brown IV (Commandant, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, DC), phone interview by the author, 1 April 2011—Maj Gen Brown was STRAT/J3N from December 2008-October 2010.

⁸⁷ Brown, phone interview.

⁸⁸ Brown, phone interview.

illustration of how USSTRATCOM failed to monitor the force providers to ensure they provided safe, secure, effective, and ready nuclear forces.⁸⁹

In *The Limits of Safety*, Scott Sagan identified a profound lack of independent oversight for U.S. nuclear weapons safety issues, and that the military commands that control the nuclear arsenal were primarily self-monitoring organizations.⁹⁰ The ability to provide the needed oversight and active monitoring was one of the great potential benefits of having a separate unified command responsible for the nuclear mission; to ensure it could perform its warfighting mission, it had to monitor the force providers.⁹¹ Sadly, USSTRATCOM's interest in and ability to monitor the force providers and counteract the providers' self-interested tendencies diminished with each additional mission, leaving an oversight vacuum filled by no other organization.⁹²

At the time of the Bent Spear in 2007, the evidence of this oversight vacuum and apparent lack of interest in the nuclear mission and nuclear safety was plainly visible to anyone who cared to look. First, no major, end-to-end nuclear exercise had occurred since 1995.⁹³ Additionally, USSTRATCOM inspectors had not observed an inspection in five years, which coincides with the beginning of USSTRATCOM's mission growth in 2002.⁹⁴

The inspector general's office was unable to continue the practice due to a combination of lack of resources, emphasis on other missions, and a decreased focus on the nuclear mission.⁹⁵ Furthermore, unless

⁸⁹ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 56, 58; DSB Task Force on Nuclear Deterrence Skills, *Report*, 36-37.

⁹⁰ Sagan, *Limits of Safety*, 269.

⁹¹ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 56, 58.

⁹² Sagan, *Limits of Safety*, 269.

⁹³ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35, C-4.

⁹⁴ DSB Task Force on Nuclear Deterrence Skills, *Report*, 37; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 34.

⁹⁵ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 34.

generated to alert status, USSTRATCOM had no operational control over bomber aircraft.⁹⁶

In addition, USSTRATCOM headquarters personnel no longer monitored the status of the nuclear forces, having delegated day-to-day monitoring to JFCC-GS.⁹⁷ Many of these problems manifested themselves in the form of inadequate operational training, proficiency, discipline, and procedures.⁹⁸ By 2007, the Air Force had clearly taken its “eye off the ball with the nuclear mission,” but went unchallenged until after the Minot Bent Spear, due in large measure to USSTRATCOM’s lack of oversight.⁹⁹

Finally, the normal accidents school claims that even if external and internal leaders agree on the need to make safety a high priority, organizational subordinates can frustrate the effort by concealing the extent of safety problems through underreporting and other techniques. In the Bent Spear case, it appears the Air Force made all required notifications and made no effort to hide the incident from USSTRATCOM. Again, USSTRATCOM’s failure to monitor the Air Force actively was the main problem, not underreporting by the Air Force.

Area of Agreement

The two schools agree that safety drops significantly when leaders do not have strong personal incentives to improve safety. When Sagan wrote *The Limits of Safety*, the prospect of accidental nuclear war still loomed large enough to claim that “because the president would be a victim (indeed, potentially one of the first victims) in a nuclear war, even

⁹⁶ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11; Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 55.

⁹⁷ Vaughn, phone interview.

⁹⁸ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 4, 35-36, 39, 55; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 6-7, 11-13; DSB Task Force on Nuclear Deterrence Skills, *Report*, viii-ix, 36-38, 74; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 54-56, 58.

⁹⁹ Michael Hoffman, “Warhead Mishap Drives Change in Nuclear Handling Procedures,” *Air Force Times*, 11 February 2008.

a normal accident theorist would expect that nuclear weapons safety would be a high priority of all American presidents.”¹⁰⁰ By 2007, the situation was much different. In the foreword to the 2001 NPR, then Secretary of Defense Donald H. Rumsfeld declared, “the U.S. will no longer plan, size or sustain its forces as though Russia presented merely a smaller version of the threat posed by the former Soviet Union.”¹⁰¹

Thus, as the Cold War standoff faded, the threat of accidental nuclear war faded along with it, and so did U.S. leaders’ personal incentives to improve nuclear weapons safety. Such an environment once again highlights the need for USSTRATCOM to act as nuclear stewardship champion. Unfortunately, at the time of the Bent Spear, the available evidence shows USSTRATCOM could not assume this role, because the nuclear mission and nuclear weapons safety were not its top priorities.

Corrective Actions and Assessment

The evidence Scott Sagan presented in his 1993 book, *The Limits of Safety*, highlighted difficulties with attaining high levels of safety in nuclear operations, even when safety is a very high leadership priority.¹⁰² Based on the available evidence, the 2007 Bent Spear did not occur in spite of nuclear weapons safety’s status as USSTRATCOM’s top leadership priority. In fact, USSTRATCOM contributed to the Bent Spear by not making the nuclear mission and nuclear weapons safety a top priority. However, under Gen Kevin P. Chilton, USSTRATCOM commander from October 2007 to January 2011, the command made much progress toward correcting this shortfall.

USSTRATCOM took several actions to improve its stewardship of the nuclear mission. Many of the actions are associated with the J3N,

¹⁰⁰ Sagan, *Limits of Safety*, 50.

¹⁰¹ Department of Defense, *Foreword: Nuclear Posture Review Report* (Washington, DC: 31 December 2001), <http://www.defense.gov/news/jan2002/d20020109npr.pdf>.

¹⁰² Sagan, *Limits of Safety*, 255.

who serves as USSTRATCOM's focal point for the nuclear mission within the headquarters and the commander's day-to-day conduit to the nuclear forces.¹⁰³ These actions include: active daily force monitoring and continual reviews of nuclear readiness; visits to every nuclear unit to communicate to those who directly perform the mission their importance, the mission's importance, and to reinforce the operational chain of command; establishing a nuclear enterprise council (NEC) and a nuclear enterprise board (NEB) to improve sustainment and operational oversight; coordination on any nuclear weapons movements; and improved nuclear enterprise advocacy.¹⁰⁴ The J3N chairs the NEB, facilitates the NEC, and has a membership role on the NEC.¹⁰⁵ The NEC, chaired by the USSTRATCOM deputy commander, is a senior-level forum for nuclear enterprise sustainment and oversight, and the NEB is a colonel-level forum for nuclear enterprise operations and oversight.¹⁰⁶

Additional actions include having a USSTRATCOM inspector observe every nuclear inspection in the Navy and Air Force, increasing general or flag officer participation in USSTRATCOM's Airborne Command Post flying mission, establishing day-to-day operational control of nuclear-capable bombers, and improving its nuclear exercise program.¹⁰⁷ These actions, in addition to the actions taken by the force

¹⁰³ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 56; Gen Kevin P. Chilton, commander, US Strategic Command (address, Air Force Association Convention, Orlando, FL, 26 February 2009); Brown, phone interview.

¹⁰⁴ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 56-57; Gen Kevin P. Chilton, commander, US Strategic Command (address, Air Force Association Convention, Orlando, FL, 26 February 2009); House Committee on Armed Services, *Statement of General C. Robert Kehler, Commander, United States Strategic Command, before the Subcommittee on Strategic Forces*, 112th Cong., 1st sess., 2 March 2011, 5; Brown, phone interview; Brig Gen Robert E. Wheeler (Deputy Director for Nuclear Operations, US Strategic Command, Offutt AFB, NE), phone interview by the author, 29 March 2011.

¹⁰⁵ Brown, phone interview.

¹⁰⁶ Brown, phone interview; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 57.

¹⁰⁷ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 55-57; Gen Kevin P. Chilton, commander, US Strategic Command (address, Air Force Association

providers, such as the Air Force no longer allowing storage of nuclear and non-nuclear missiles in the same facility, have had a positive impact on nuclear weapons safety.¹⁰⁸

However, nuclear weapons safety is just one aspect of the nuclear mission. Therefore, in order for nuclear weapons safety to become a top priority at USSTRATCOM, the nuclear mission itself must become the priority, and the command must be free to focus on the nuclear mission.

Although the noted positive actions demonstrate that the nuclear mission now holds an increased level of importance at USSTRATCOM, they are not enough to make nuclear weapons safety a top leadership priority. For instance, having a J3N flag officer is an improvement over having a colonel as the focal point for the nuclear mission within USSTRATCOM headquarters, but it is also a tacit admission that the USSTRATCOM commander cannot completely focus on the nuclear mission and nuclear weapons safety. Responsibility for eight global missions simply does not allow it. Also, in terms of the rank of those within USSTRATCOM who are responsible for the nuclear mission, the JFCC-GS commander is still a two-star general officer.¹⁰⁹ As such, he is currently outranked by two of his subordinate task force (TF) commanders, all the other three-star JFCC commanders, and the USCYBERCOM commander—a four-star general officer.¹¹⁰

In addition, USSTRATCOM's organizational structure became even more complicated with the addition of the J3N. The nuclear hierarchy within the command was already very complicated with the six nuclear TFs, JFCC-GS, and the residual headquarters staff—see chapter 1 for discussion. The J3N could come into conflict with JFCC-GS personnel at

Convention, Orlando, FL, 26 February 2009); House Committee, *Statement of General C. Robert Kehler*, 8.

¹⁰⁸ Michael Hoffman, "Warhead Mishap Drives Change in Nuclear Handling Procedures," *Air Force Times*, 11 February 2008.

¹⁰⁹ United States Strategic Command, "Mission Briefing," (version 11-03, 28 January 2011).

¹¹⁰ United States Strategic Command, "Mission Briefing," ver. 11-03.

the headquarters over operational issues, since both parties have operational concerns.

With eight global missions to manage, USSTRATCOM still has too many missions to allow nuclear weapons safety to become a top priority, despite the reduced workload at the headquarters following the standup of USCYBERCOM. General C. Robert Kehler, current USSTRATCOM commander, in a recent statement to the House Armed Services Committee's Subcommittee on Strategic Forces, discussed the command's priorities. He said, "First and foremost, we must guarantee a safe, secure, effective, and ready nuclear deterrent force."¹¹¹ Though he no doubt meant this when he said it, he diluted its impact with further statements about the importance of USSTRATCOM's seven other missions.¹¹²

There are other reasons to question whether the nuclear mission and nuclear weapons safety are more than avowed priorities. For example, anyone who goes online to find out about USSTRATCOM will read, "USSTRATCOM combines the synergy of the U.S. legacy nuclear command and control mission with responsibility for space operations; global strike; Defense Department information operations; global missile defense; and global command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR), and combating weapons of mass destruction."¹¹³ Nuclear C2 is the only mission described as a *legacy* mission, implying the nuclear mission is outdated.¹¹⁴ Even General Chilton, who did much to improve the emphasis on the nuclear mission, said in a March 2010 statement, "we

¹¹¹ House Committee, *Statement of General C. Robert Kehler*, 3.

¹¹² House Committee, *Statement of General C. Robert Kehler*, 3-4, 10-22.

¹¹³ United States Strategic Command, "About USSTRATCOM," <http://www.stratcom.mil/about/>.

¹¹⁴ Merriam-Webster Online Dictionary, s.v. "legacy," <http://www.merriam-webster.com/dictionary/legacy> (accessed 2 April 2011).

should continually consider to what degree nuclear weapons remain relevant.”¹¹⁵

Other indicators call into question the priority of the nuclear mission and nuclear weapons safety at USSTRATCOM. For example, the headquarters does not even track nuclear weapons safety mishap data.¹¹⁶ Finally, although the force providers initiated many actions to improve the priority of the nuclear mission and nuclear weapons safety, some lapses remain, including the fact that Barksdale AFB still does not have its own weapons storage area.¹¹⁷ If USSTRATCOM had tried, it could not convince the Air Force it is a high enough priority to fund.¹¹⁸ In short, the nuclear mission suffered a long decline, and though progress is evident, the long, uphill climb required in order to return it to prominence and priority is in the very early stages.

This chapter noted the link between redundancy and safety as a top leadership priority. Safety must be a top priority, so leaders will provide the necessary level of redundancy for safe operations, which is very expensive.¹¹⁹ The next chapter explores redundancy from the perspectives of both schools, examines its role in the Bent Spear and USSTRATCOM’s posture in relation to it, and assesses whether corrective actions have improved USSTRATCOM’s safety posture.

¹¹⁵ Senate Committee on Armed Services, *Statement of General Kevin P. Chilton, Commander, United States Strategic Command*, 111th Cong., 2d sess., 24 March 2010, 8.

¹¹⁶ Bobby Neal, USSTRATCOM civilian, to the author, e-mail, 4 January 2011. The author was informed that USSTRATCOM is not the repository for such data.

¹¹⁷ Air Force Association, “No Weapons Storage Area for Barksdale,” AirForce-Magazine.com, 23 February 2011, <http://www.airforce-magazine.com/DRArchive/Pages/2011/February%202011/February%2023%202011/NoWeaponsStorageAreaforBarksdale.aspx>.

¹¹⁸ Air Force Association, “No Weapons Storage Area for Barksdale,” AirForce-Magazine.com, 23 February 2011, <http://www.airforce-magazine.com/DRArchive/Pages/2011/February%202011/February%2023%202011/NoWeaponsStorageAreaforBarksdale.aspx>.

¹¹⁹ Sagan, *Limits of Safety*, 18.

Chapter 4

Redundant Safety Measures

*Our system has to be robust enough to protect us
from human error.*

Senator John Thune

This chapter's purpose is to evaluate USSTRATCOM's use of redundant safety measures around the time of the 30 August 2007 Minot Bent Spear and to assess how much improvement has been made in this area since that time. The chapter begins with an overview of the high reliability school's claims about the importance of redundant safety measures. Next, I cover the counterclaims made by the normal accidents school, along with an area of agreement between the two schools about redundancy. These two sections summarize the material about this factor in Sagan's *The Limits of Safety*. Then, I evaluate USSTRATCOM's use of redundant safety measures around the time of the Bent Spear—first from the high reliability school's perspective, then from the normal accidents school's perspective, and finally in relation to the area of agreement between the two schools. Finally, I review pertinent corrective actions taken by USSTRATCOM in response to the Bent Spear and assess their impact on its safety posture.

High Reliability School Perspective

Human beings are obviously imperfect, mistake-prone creatures. The high reliability school asserts that redundancy, in the form of duplication and overlap, is the key for high reliability organizations to overcome human fallibility.¹ Duplication occurs when two different units

¹ Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton, NJ: Princeton University Press, 1993), 19-20.

perform the same function, while overlap involves “two units with some functional areas in common.”² Technical redundancy, such as backup components and systems or those with related purposes, comprises the first type of duplication and overlap.³ Personnel redundancy, such as multiple verifications of equipment settings and shared duties, comprises the second basic type.⁴ High reliability scholars identified redundancy as an essential factor in the safe operations of virtually all the high reliability systems or organizations studied, from the air traffic control system to nuclear reactors, and from aircraft carriers to the human immune system.⁵

Normal Accidents School Perspective and Agreement

The normal accidents school claims that adding redundant safety measures can actually increase the likelihood of accidents for three main reasons.⁶ First, redundant measures are often less independent than believed, which can increase interactive complexity and lead to common-mode failures. For example, “the 1986 Chernobyl accident was caused by a test of backup safety power sources.”⁷ Second, redundant measures can often make systems more opaque, thus masking individual failures and raising the likelihood that problems will go unaddressed.⁸ If left unaddressed, problems can accumulate and emerge later as common-mode failures and simultaneous failures of multiple components.⁹ Third, managers and operators will often see redundant measures as an opportunity to increase production to more dangerous levels.¹⁰

² Sagan, *Limits of Safety*, 20.

³ Sagan, *Limits of Safety*, 20.

⁴ Sagan, *Limits of Safety*, 20.

⁵ Sagan, *Limits of Safety*, 20-21.

⁶ Sagan, *Limits of Safety*, 39.

⁷ Sagan, *Limits of Safety*, 39.

⁸ Sagan, *Limits of Safety*, 39.

⁹ Sagan, *Limits of Safety*, 39-40.

¹⁰ Sagan, *Limits of Safety*, 40.

However, the two schools agree that if truly independent, redundant measures can improve safety and reliability.¹¹ As noted in chapter 2, from the normal accidents school's perspective, adequate safety redundancies in tightly coupled systems are mainly limited to those deliberately built into the system upfront.¹² In contrast, loosely coupled systems provide much greater flexibility as far as when to add redundant measures.¹³ In addition, the normal accidents school claims that the greater the interactive complexity, the more difficult it becomes to design and build truly independent, redundant measures into a system due to the inability to anticipate the various interactions among system components.¹⁴ In contrast, the high reliability school does not restrict the successful employment of redundancies to certain times or conditions.¹⁵

Bent Spear and USSTRATCOM's Use of Redundancy

Having covered the differing perspectives of the two competing schools, as well as their area of agreement, I now evaluate USSTRATCOM's use of redundant safety measures around the time of the Bent Spear. My evaluation proceeds from the lens of the high reliability school to the normal accidents school to the area of agreement between the two schools.

High Reliability School

The 30 August 2007 Bent Spear validated that human beings are mistake-prone creatures. The Bent Spear revealed a series of mistakes, especially by those who did not verify the ACM payloads through negligence, complacency, inadequate proficiency, or some combination of

¹¹ Sagan, *Limits of Safety*, 39.

¹² Sagan, *Limits of Safety*, 34.

¹³ Sagan, *Limits of Safety*, 34.

¹⁴ Sagan, *Limits of Safety*, 33.

¹⁵ Sagan, *Limits of Safety*, 19-21.

the three.¹⁶ These individuals also displayed a lack of attention to detail and checklist discipline.¹⁷

Overreliance on personnel redundancy and the absence of technical redundancy characterized the Bent Spear mishap. The multiple verifications were an example of overlapping personnel redundancy, since each crew or weapons handler had different primary responsibilities but the same requirement to verify the ACM payload status.¹⁸ There is no evidence of the use of technical redundancy to augment the personnel redundancy, perhaps due to lack of funding. Therefore, the only apparent measure taken to compensate for the known problem of human fallibility was to require additional fallible humans to conduct the same verifications. Although this approach can prove beneficial, it clearly failed in this case.

Some type of technical redundant safety measure could have proved beneficial in the Bent Spear case. For instance, something as simple as a bar code scanner to scan bar codes affixed to the pylons prepared for the tactical ferry missions could possibly have prevented the wrong pylon from leaving the storage facility. Recall the first step in the process was to prepare the scheduled ACMs for tactical ferry by removing the nuclear warheads to make the ACMs inert.¹⁹ The removal occurred at Minot's Integrated Maintenance Facility, where the technicians could have applied the bar codes to the pylons and movement plan.²⁰ Procedures then could have required the breakout crew to scan the bar

¹⁶ Defense Science Board Task Force on Nuclear Weapons Surety, *Report on the Unauthorized Movement of Nuclear Weapons* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, April 2008), 3, 5.

¹⁷ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3, 5.

¹⁸ Sagan, *Limits of Safety*, 20.

¹⁹ Department of Defense Inspector General, *Oversight of the Investigation Directed by the Commander, Air Combat Command Concerning an Unauthorized Transfer of Classified Material from Minot Air Force Base, North Dakota to Barksdale Air Force Base, Louisiana on August 30, 2007*, (Washington, DC: 8 February 2008), 4, in Senate, *Air Force Nuclear Security: Hearing before the Committee on Armed Services*, 110th Cong., 2d sess., 12 February 2008, 34.

²⁰ DoD IG, *Oversight of the Investigation*, 4, in Senate, *Air Force Nuclear Security*, 34.

codes on the pylons to ensure it had identified the correct pylons. Maintenance operations center or command post personnel could then have verified the scan results matched the movement plan before removal from the storage facility.

Another possible technical redundant safety measure that could have helped is some type of detector for the plutonium or enriched uranium used in nuclear warheads. This measure would be more sophisticated, independent, and almost certainly more expensive than a bar code scanner. The detector could have sounded an alarm if an unauthorized movement of nuclear warheads occurred. The detector and bar code scanner are just two possible ways that technical redundancy could have augmented personnel redundancy. Of course, any redundant measure would have its pros and cons, and must undergo careful testing and evaluation before implementation, but complete reliance on personnel redundancy was unwise.

Calls for redundancy must eventually address the question, *how much is enough?* This is a difficult question to answer with certainty in most cases. With unlimited resources, one could design a system with any number of personnel and technical redundant safety measures. In reality, there are always resource constraints, and there are often competing calls for efficiency and streamlined operations.²¹ One way to help answer the question is to determine safety's priority in relation to other priorities. If safety is a top priority and serious accidents are not an option, then the organization or system needs enough redundancy to minimize the likelihood of such accidents to the lowest level possible.

By the time of the Bent Spear, the nuclear mission had clearly become a lower priority in the DoD, USSTRATCOM, and the Air Force, which meant fewer resources for nuclear programs and redundant safety measures. The following quote illustrates this problem:

²¹ Sagan, *Limits of Safety*, 20.

Since the 1990s, there has been a shedding of nuclear capabilities by the Military Services. Such efforts are sometimes abetted by combatant commands and by service components in order to free up resources to use elsewhere. In some cases, the Services have perfected the art of starving a capability in order to justify shedding the associated mission, a phenomenon the Task Force observed in other areas, not just nuclear programs. For example, the criterion employed by some in the military for procuring a weapons system (specifically TLAM-N [Tomahawk Land-Attack Missile–Nuclear], ALCM [Air-Launched Cruise Missile], and dual-capable aircraft, especially in NATO) is whether it is “militarily cost-effective.” This ignores the weapon’s political value, overlooking the crucial deterrence and assurance elements that these nuclear deployments and capabilities provide.²²

The lack of resources for nuclear programs in general may help explain why the Air Force did not use other types of redundant safety measures to help prevent the Bent Spear.

As discussed in chapter 3, USSTRATCOM has an important independent oversight responsibility. In terms of redundancy, this effectively is a form of overlap, since it has different primary responsibilities from the force providers but the same requirement to ensure the safety of the nuclear arsenal.²³ The distinction between duplicate and overlapping forms of redundancy is important in this case.

Again, USSTRATCOM has responsibility for targeting, planning, and employment of strategic nuclear forces, while the Air Force and Navy have organize, train, and equip responsibilities.²⁴ Therefore, USSTRATCOM may not always have direct responsibility for the safety and security of strategic nuclear forces, but it always has indirect responsibility for them as a demanding customer of the force providers. Though it did not have direct responsibility for the nuclear weapons

²² Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase II Report: Review of the DoD Nuclear Mission* (Arlington, VA: December 2008), vi.

²³ Sagan, *Limits of Safety*, 20.

²⁴ United States Strategic Command, “History,” <http://www.stratcom.mil/history>.

involved in the Bent Spear, USSTRATCOM failed to provide the needed oversight to prevent the incident due to mission growth and loss of focus on the nuclear mission.²⁵

Normal Accidents School

From the normal accidents school's perspective, it is important to determine whether a redundant safety measure actually contributed to the Bent Spear and if so, why it did. At first glance, it might be tempting to view Minot's internal paperwork process as a needless redundancy that helped cause the Bent Spear. This assessment may be true, but it is irrelevant for this aspect of the study, because the purpose of the redundant internal paperwork was to facilitate daily maintenance operations, not to improve safety.²⁶

Again, the only discernible redundant safety measure employed in the Bent Spear was the multiple ACM payload verifications by various weapons handlers and crews. However, there is little reason to believe that this measure, though clearly insufficient to prevent the Bent Spear, actually increased the likelihood of the incident per the normal accidents school's claims. First, whether the redundant verifications were independent is not really an issue, because the actual ACM movement process, from storage facility to aircraft loading, was clearly a linear process, as opposed to an interactively complex process—see figure 2.²⁷ Here, the distinction between the overall tactical ferry missions, which displayed high interactive complexity—see chapter 3, and the ACM movement process is critical. The ACM movement process resembled an automobile assembly line, the prototypical linear system, rather than an interactively complex system with unexpected sequences, which are

²⁵ See, for example, DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11.

²⁶ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 3.

²⁷ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 2.

either invisible or not immediately comprehensible.²⁸ Thus, one should view the various redundant payload verifications as part of the visible and familiar ACM movement sequence.²⁹

Next, the redundant personnel verifications did not increase the opaqueness of the system, because they were a visible and expected part of the linear movement process. Rather than some complex common-mode failure, the main cause of the failure to verify the ACM payloads properly was most likely complacency or some other common source of human fallibility.

Third, although chapter 3 noted some signs of production pressure, there is no reason to believe that those in charge of the tactical ferry missions viewed the redundant personnel verifications as an opportunity to increase production to a dangerous level. In fact, the impression one gets from the various Bent Spear reports is that the missions had become routine, perhaps too routine. Again, the 30 August 2007 mission was the sixth of 12 planned missions, and the two bomb wings involved had the flexibility to schedule the missions around other requirements.³⁰ No one expected nuclear weapons to become involved, and those responsible for the verifications seem to have discounted this possibility.³¹ These facts once again point to complacency or another common source of human fallibility as the likely cause of the failure to verify the ACM payloads, not interactive complexity or a related phenomenon.

Area of Agreement

Since the two schools agree that if truly independent, redundant measures can improve safety and reliability, it is important to determine, per the normal accidents school's claims, if the structure of the system

²⁸ Sagan, *Limits of Safety*, 32.

²⁹ Sagan, *Limits of Safety*, 32.

³⁰ DoD IG, *Oversight of the Investigation*, 2, 4, in Senate, *Air Force Nuclear Security*, 32, 34.

³¹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

that governed the Bent Spear allowed for independent redundancies. If so, then it is also important to determine if those in authority used such redundancies to prevent the Bent Spear. First, as noted previously, loose coupling characterized the Bent Spear, so there was great flexibility as far as when to add redundant safety measures. In addition, if one restricts consideration to the ACM movement process, interactive complexity did not apply, so the possibility existed to design and build independent, redundant measures into the process. However, those with responsibility, either directly or indirectly, did not use any redundant measures beyond the multiple ACM payload verifications by various weapons handlers and crews to prevent the Bent Spear.

Corrective Actions and Assessment

Oversight and monitoring are the main areas of improvement undertaken by USSTRATCOM in response to the Bent Spear that relate to redundancy. Again, USSTRATCOM has an important independent oversight responsibility, and in terms of redundancy, has an overlapping responsibility for nuclear weapons safety with the force providers.³²

After the Bent Spear, USSTRATCOM became a more demanding customer of the force providers by requiring more information about the status of nuclear forces from them than they had grown accustomed to providing.³³ USSTRATCOM issued directives to its TFs via nuclear operations orders to provide the information.³⁴ Today, USSTRATCOM monitors force readiness status on a continual basis to ensure it can execute the nuclear operations plan at a moment's notice.³⁵

³² Sagan, *Limits of Safety*, 20.

³³ Michael G. Vaughn (Contractor, US Strategic Command, Offutt AFB, NE), phone interview by the author, 7 April 2011—Col Vaughn, USAF, retired, was STRAT/J38 (Chief, Nuclear Operations and C2 Division) from June 2008-December 2010.

³⁴ Vaughn, phone interview.

³⁵ Brig Gen Robert E. Wheeler (Deputy Director for Nuclear Operations, US Strategic Command, Offutt AFB, NE), phone interview by the author, 29 March 2011; Maj Gen Joseph D. Brown IV (Commandant, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, DC), phone interview by the author, 1 April 2011—Maj Gen Brown was STRAT/J3N from December 2008-October 2010.

USSTRATCOM took other actions to improve its oversight and monitoring of the force providers. Of course, establishing combatant command and operational control of the nuclear-capable bomber force gives USSTRATCOM better oversight capability and a stronger voice in balancing the competing demands of these multi-role platforms.³⁶ Additionally, both the NEC and NEB serve as oversight forums and meet every six months.³⁷ Recall the NEC is a senior-level forum for nuclear enterprise sustainment and oversight, and the NEB is a colonel-level forum for nuclear enterprise operations and oversight.³⁸ Finally, USSTRATCOM now requires its coordination on any nuclear weapons movements involving the mating or demating to a weapons system.³⁹

Strengthened USSTRATCOM advocacy for needed resources is another area that could improve the use of redundancy. The NEB and NEC, in addition to oversight forums, serve as advocacy forums.⁴⁰ Committee and board members can address resource needs via these forums, and if not solvable at their level, the NEB and NEC can elevate needs to the USSTRATCOM commander. The USSTRATCOM commander testifies regularly before Congress and advocates for nuclear enterprise resources while there, as well as through various joint military channels.⁴¹

³⁶ House Committee on Armed Services, *Statement of General C. Robert Kehler, Commander, United States Strategic Command, before the Subcommittee on Strategic Forces*, 112th Cong., 1st sess., 2 March 2011, 8; Brown, phone interview.

³⁷ Brown, phone interview; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 57; Vaughn, phone interview.

³⁸ Brown, phone interview; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 57; Gen Kevin P. Chilton, commander, US Strategic Command (address, Air Force Association Convention, Orlando, FL, 26 February 2009).

³⁹ Brown, phone interview.

⁴⁰ Brown, phone interview; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 57; Gen Kevin P. Chilton, commander, US Strategic Command (address, Air Force Association Convention, Orlando, FL, 26 February 2009).

⁴¹ See, for example, House Committee, *Statement of General C. Robert Kehler*, 5; House Committee on Armed Services, *Statement of General Kevin P. Chilton, Commander, United States Strategic Command*, 111th Cong., 2d sess., 14 April 2010, 2-4; Senate Committee on Armed Services, *Statement of General Kevin P. Chilton, Commander*,

Although USSTRATCOM has greatly improved its oversight and monitoring of the force providers, there are still gaps in USSTRATCOM's overlapping safety redundancy. For instance, USSTRATCOM's purview does not currently extend to the weapons when they are in storage or undergoing maintenance in a weapons storage area.⁴² In order to maximize its oversight effectiveness, no area should be off limits to USSTRATCOM's monitoring. Otherwise, it cannot "guarantee a safe, secure, effective, and ready nuclear deterrent force."⁴³

In addition, USSTRATCOM should consider additional measures to improve the use of redundancy in the nuclear arsenal. Based on the Bent Spear, USSTRATCOM should strive to avoid situations that involve complete reliance on either personnel or technical redundancy to ensure safety. The best approach will likely involve a mix of both types.

Although most aspects of the nuclear arsenal have significant levels of redundancy by design, USSTRATCOM should explore ways to reduce further the possibility of accidental or unauthorized nuclear detonations or accidental nuclear war through redundant safety measures. One possibility is to install remote destruct devices on all nuclear missiles.⁴⁴ Of course, there are many other possibilities, but any initiative to expand the use of redundant measures will require strong advocacy, because of the very tough fiscal environment expected in the coming years.

United States Strategic Command, 111th Cong., 2d sess., 24 March 2010, 8-11; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 57; Brown, phone interview; Wheeler, phone interview.

⁴² Brown, phone interview. The Air Force announced on 27 April 2011 that it plans to transfer its munitions units that support the nuclear mission from Air Force Materiel Command to Air Force Global Strike Command. By realigning these units under USSTRATCOM's Air Force service component, this action provides USSTRATCOM with an opportunity to improve its oversight of nuclear weapons activities in the weapons storage areas. For details on the planned unit transfers, see Vicki Stein, "Continuing to Strengthen Nuclear Operations: Munitions Squadrons to Realign," *Air Force Print News*, 27 April 2011, <http://www.af.mil/news/story.asp?id=123253447>.

⁴³ House Committee, *Statement of General C. Robert Kehler*, 3.

⁴⁴ Sagan, *Limits of Safety*, 277.

In short, USSTRATCOM's safety posture in relation to the use of redundant safety measures and its role as an organization with an overlapping safety redundancy responsibility is much stronger than it was around the time of the Bent Spear. However, the need for improvement remains and will take a concerted effort to leverage the full potential of redundant measures to maximize safety.

High reliability scholars have identified three related operations and management characteristics to augment redundancy and to avoid relying solely on redundancy to prevent accidents.⁴⁵ These characteristics compose the next safety factor—a high reliability culture developed through decentralized decision-making and continually practiced operations.⁴⁶ The next chapter explores this factor from the perspectives of both schools, examines its role in the Bent Spear and USSTRATCOM's posture in relation to it, and assesses whether corrective actions have improved USSTRATCOM's safety posture.

⁴⁵ Sagan, *Limits of Safety*, 21-22.

⁴⁶ Sagan, *Limits of Safety*, 17.

Chapter 5

Culture, Decentralization, and Continuous Operations

One of the great enemies of high reliability is the...combination of stability, routinization, and lack of challenge and variety that predispose an organization to relax vigilance and sink into a dangerous complacency that can lead to carelessness and error.

Gene I. Rochlin, Todd R. LaPorte, and Karlene H. Roberts

This chapter has two purposes. One is to evaluate whether USSTRATCOM helped establish or maintain a high reliability nuclear operations culture through decentralized decision-making and continually practiced operations around the time of the Minot Bent Spear. The other is to assess how much improvement USSTRATCOM has made in this area since that time. The chapter begins with an overview of the high reliability school's claims about the importance of this factor. Next, I cover the counterclaims made by the normal accidents school, followed by the areas of agreement between the two schools. These sections summarize the arguments from the two competing schools about this factor in Sagan's *The Limits of Safety*. Then, I evaluate whether USSTRATCOM helped establish or maintain a high reliability nuclear operations culture through decentralized decision-making and continually practiced operations around the time of the Bent Spear. I use the same pattern of analysis from previous chapters to assess USSTRATCOM's safety posture in relation to the Bent Spear and to assess its current safety posture.

High Reliability School Perspective

The high reliability school has identified three interrelated and mutually reinforcing characteristics to comprise its third critical factor for extremely reliable and safe operations.¹ These characteristics are decentralized decision-making authority, the development of a high reliability culture, and continually practiced operations.² First, decentralized decision-making authority allows those who are the closest to potential safety problems to assess a situation and respond rapidly in a manner they deem appropriate at the earliest opportunity.³

Second, the development of a high reliability culture, based on the centralized recruitment, socialization, and training of personnel, enables decentralization by giving lower-level personnel a common set of decision premises and assumptions.⁴ These tools allow personnel to assess situations similarly and respond in approved ways.⁵

Third, continually practiced operations, through a constant process of on-the-job training, realistic simulations, and challenging on-going operations, give personnel the knowledge, proficiency, and experience to deal with challenging situations effectively and help avoid complacency.⁶ For example, high reliability scholars have observed the beneficial combined effect of these characteristics in the U.S. air traffic control system and aircraft carrier operations.⁷

Normal Accidents School Perspective and Agreement

Based on the effects of interactive complexity and tight coupling, the normal accidents school presents several counterclaims for the high reliability school's claims regarding culture, decentralization, and continuous operations. First, the normal accidents school acknowledges

¹ Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton, NJ: Princeton University Press, 1993), 17, 22, 24.

² Sagan, *Limits of Safety*, 22-24, 27.

³ Sagan, *Limits of Safety*, 22.

⁴ Sagan, *Limits of Safety*, 23.

⁵ Sagan, *Limits of Safety*, 23.

⁶ Sagan, *Limits of Safety*, 24.

⁷ Sagan, *Limits of Safety*, 22-24.

the need for decentralized decision-making authority to deal with the effects of interactive complexity.⁸ However, it sees a contradiction in the fact that tightly coupled systems demand highly centralized decision-making due to the requirement for immediate responses and dim prospect for recovery if low-level decisions are wrong.⁹ Therefore, if a system has both high interactive complexity and tight coupling, neither strict centralization nor decentralization can ensure safety.¹⁰

Next, the normal accidents school claims that leaders often do not know enough about their operations to provide guidance as to how lower-level personnel should respond in all situations, which hinders the development of a high reliability culture.¹¹ In addition, the school claims that if the decision premises and assumptions given to lower-level personnel do not fit the situation, then the uniform responses expected from them may actually decrease safety.¹² Furthermore, the school claims the intense socialization and conformity required to develop a high reliability culture will often fail due to incompatibility with individualistic and democratic societal values.¹³

Third, the school claims that continually practiced operations yield limited benefits, because organizations cannot practice unimagined scenarios that sometimes occur.¹⁴ Furthermore, organizations rarely, if ever, practice extremely dangerous operations due to the fact they are so dangerous.¹⁵ In addition, organizations that find themselves in a politicized environment will likely shun politically distasteful scenarios.¹⁶

⁸ Sagan, *Limits of Safety*, 40.

⁹ Sagan, *Limits of Safety*, 40.

¹⁰ Sagan, *Limits of Safety*, 40.

¹¹ Sagan, *Limits of Safety*, 40.

¹² Sagan, *Limits of Safety*, 40-41.

¹³ Sagan, *Limits of Safety*, 41, 46.

¹⁴ Sagan, *Limits of Safety*, 41.

¹⁵ Sagan, *Limits of Safety*, 41.

¹⁶ Sagan, *Limits of Safety*, 41.

However, there are two areas of agreement between the two schools with regard to this factor. First, they agree that in principle continually practiced operations can help improve safety, but the normal accidents school claims the effects are limited for the reasons noted above.¹⁷ The two schools also agree that the ideal military model, characterized by isolation from society, intense socialization, and strict discipline, can enhance safety by fostering a culture of reliability.¹⁸

Bent Spear and USSTRATCOM—Culture, Decentralization, and Continuous Operations

Having covered the differing perspectives of the two competing schools, as well as their area of agreement, I now evaluate whether USSTRATCOM developed a high reliability culture through decentralized decision-making and continually practiced operations around the time of the Bent Spear. My evaluation proceeds from the lens of the high reliability school to the normal accidents school to the area of agreement between the two schools.

High Reliability School

The available evidence from the Bent Spear does not indicate a lack of decentralized decision-making authority. Rather, it appears there was an abundance of decentralized authority without the required reinforcement for safe operations from a high reliability culture perspective and continually practiced operations. This condition allowed those in direct contact with the weapons to take adverse actions without appropriate supervision and without the tools needed to assess the situation properly and respond appropriately. For instance, the change

¹⁷ Sagan, *Limits of Safety*, 41.

¹⁸ Sagan, *Limits of Safety*, 50.

to the movement plan by Minot's 5th Munitions Maintenance Squadron indicates decentralized decision-making authority.¹⁹

Similarly, the breakout and convoy crews' change of the procedures for initial status verification and pylon trailer tow preparation in order to expedite the ACM movement process reflected decentralized authority.²⁰ Finally, the change from distinguishing nuclear-inert ACMs with placards on multiple sides of the pylon and orange cones around it to placing one 8 x 10 in. piece of paper somewhere on the pylon and no orange cones reflected decentralized authority.²¹ These latter two changes "occurred without adequate review and approval above the wing level,"²² while Air Combat Command's investigating officer described the supervision style at the wing level and below as "too much trust and no verification."²³

From all indications, the absence of a high reliability culture contributed to the Bent Spear. By the time of the Bent Spear, it appears that any culture of reliability that may have once existed had declined sharply and accompanied the broadly perceived devaluing and loss of focus on the nuclear mission.²⁴ As covered in chapter 3, the actions,

¹⁹ Defense Science Board Task Force on Nuclear Weapons Surety, *Report on the Unauthorized Movement of Nuclear Weapons* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, April 2008), 3.

²⁰ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

²¹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

²² DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

²³ Department of Defense Inspector General, *Oversight of the Investigation Directed by the Commander, Air Combat Command Concerning an Unauthorized Transfer of Classified Material from Minot Air Force Base, North Dakota to Barksdale Air Force Base, Louisiana on August 30, 2007*, (Washington, DC: 8 February 2008), 5, in Senate, *Air Force Nuclear Security: Hearing before the Committee on Armed Services*, 110th Cong., 2d sess., 12 February 2008, 35.

²⁴ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7, 9, 11-19; Defense Science Board Task Force on Nuclear Deterrence Skills, *Report* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, September 2008), vi-vii, 15, 59; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase I Report: The Air Force's Nuclear Mission* (Arlington, VA: September 2008), 22-23, 29-32; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase II Report: Review of the DoD Nuclear Mission* (Arlington, VA: December 2008), 55.

comments, and survey responses of lower-level nuclear personnel provided ample evidence of this decline. Though not solely confined to the nuclear-capable bomber community, it is where the decline in a culture of reliability was most evident.²⁵ The most telling example of how far the culture had deteriorated, aside from the Bent Spear itself, occurred in May 2008 during the 5th Bomb Wing's nuclear surety inspection (NSI). A security forces Airman chose to play video games on his cell phone during an exercise when his duties required him to guard the restricted area's perimeter.²⁶ The wing went on to fail the inspection, its second failure in a row after the Bent Spear.²⁷ The fact that this incident happened at Minot, in the aftermath of the Bent Spear, during an inspection, and after months of opportunity to prepare is incomprehensible apart from an appreciation of the pernicious influence of the prevailing culture.²⁸

Since training is a key aspect of both culture and continually practiced operations, it should come as no surprise that the Bent Spear also revealed the absence of continually practiced nuclear operations. This absence left personnel without the knowledge, proficiency, and experience to deal with challenging situations effectively and helped foster complacency.

The signs of this absence were obvious. For instance, the Defense Science Board task force that investigated the Bent Spear noted "significant confusion" among several of the breakout crews, convoy crews, load crews, and aircrews with whom it held discussions over the

²⁵ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11-13; Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 22-23, 29-32.

²⁶ Michael Hoffman, "5th Bomb Wing Flunks Nuclear Inspection," *Air Force Times*, 30 May 2008.

²⁷ Michael Hoffman, "5th Bomb Wing Flunks Nuclear Inspection," *Air Force Times*, 30 May 2008.

²⁸ Michael Hoffman, "5th Bomb Wing Flunks Nuclear Inspection," *Air Force Times*, 30 May 2008.

procedural requirements for ACM movement.²⁹ Specifically, there was confusion about how to comply with the checklist requirement to “verify which payload is installed.”³⁰ “Some did not interpret *verify* as requiring a physical check.”³¹ The fact that a checklist step for nuclear weapons movement required interpretation was a sure sign of a seriously deficient training program and a lack of challenging on-going operations.

Furthermore, as far as training in the bomber leg, the conventional mission dominated nuclear mission preparation to such an extent that only the restricted area, where nuclear weapons are maintained and stored, saw daily attention on the nuclear mission.³² Additionally, neither the B-52 initial training, nor the advanced weapons school courses had flying sorties devoted to the nuclear mission.³³ Instead, each course only included a single simulator mission focused on the nuclear mission.³⁴ By 2007, most bomber personnel had never experienced nuclear alert, and though most of the B-52s were at Barksdale AFB, the base did not have its own nuclear weapons storage area for local training.³⁵ Consequently, B-52 aircrews and weapons handlers estimated they spent only about 5 to 20 percent of their time on the nuclear mission.³⁶

The problems with a lack of continually practiced operations and culture in the nuclear bomber force go back to the decision to take the

²⁹ Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

³⁰ Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

³¹ Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

³² DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12-13.

³³ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12-13.

³⁴ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

³⁵ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12; DSB Task Force on Nuclear Deterrence Skills, *Report*, 38; Air Force Association, “No Weapons Storage Area for Barksdale,” AirForce-Magazine.com, 23 February 2011, <http://www.airforce-magazine.com/DRArchive/Pages/2011/February%202011/February%2023%202011/NoWeaponsStorageAreaforBarksdale.aspx>.

³⁶ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11.

bombers off alert in September 1991.³⁷ Without daily nuclear alert, the focus naturally shifted to conventional operations and proficiency levels in nuclear operations atrophied.³⁸ As noted, high levels of redundancy and continuous training are both necessary and very expensive.³⁹ As was the case for redundancy, the same resource-constrained environment that plagued nuclear programs in general, limited the resources available for continually practiced operations.

The force providers clearly had primary responsibility for continually practiced operations as part of their organize, train, and equip responsibilities and largely determined the type of culture developed and level of decentralized decision-making authority granted. Here again, USSTRATCOM had an influential role to play as the responsible warfighting command and focal point for the nuclear deterrence mission within the DoD.

Unfortunately, USSTRATCOM was not in a position, for two reasons, to detect and correct the imbalance between highly decentralized decision-making authority and the absence of both a high reliability culture and continually practiced operations that contributed to the Bent Spear. First, its purview did not extend to the Air Force's activities within the weapons storage area.⁴⁰ Second, as previously discussed, USSTRATCOM failed to provide the needed oversight and

³⁷ Lawrence Freedman, *The Evolution of Nuclear Strategy*, 3rd ed. (New York: Palgrave Macmillan, 2003), 422-23; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 15.

³⁸ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 3, 22-23, 52; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12; Senate, *Air Force Nuclear Security: Hearing before the Committee on Armed Services*, 110th Cong., 2d sess., 12 February 2008, 8.

³⁹ Sagan, *Limits of Safety*, 18.

⁴⁰ Maj Gen Joseph D. Brown IV (Commandant, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, DC), phone interview by the author, 1 April 2011—Maj Gen Brown was STRAT/J3N from December 2008-October 2010.

resource advocacy due to its mission growth and corresponding loss of focus on the nuclear mission at the headquarters.⁴¹

Around the time of the Bent Spear, there was ample evidence of USSTRATCOM's deficiencies with respect to this factor. In addition to a general lack of oversight and resource advocacy, its deficiencies were most visible in the areas of procedures, exercises, and inspections. First, as far as the changed procedures involved in the Bent Spear, USSTRATCOM was effectively out of the loop as far as weapons storage area procedural guidance due to its limited purview. Where its purview did extend, USSTRATCOM failed to correct an Air Force process that required field-level personnel "to rely on outdated, inaccurate, or ambiguous guidance."⁴² An example of ambiguous guidance from the Bent Spear involved how to distinguish nuclear-inert ACMs pylons.⁴³ The formal requirement was simply to identify them with readily visible markings, which left too much to interpretation—an easily correctable problem with a proper review process.⁴⁴

Second, no major, end-to-end nuclear exercise had occurred since 1995.⁴⁵ USSTRATCOM-sponsored exercises have the same internal purpose as a local training program—proficiency, and became more critical in the absence of challenging on-going operations after the decision to take the bombers off alert.⁴⁶ Such exercises augment local training by providing the opportunity to practice operations in a realistic and demanding environment with a focus on enhanced learning. They

⁴¹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 55.

⁴² Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 33.

⁴³ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

⁴⁴ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

⁴⁵ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35, C-4.

⁴⁶ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

also give USSTRATCOM the opportunity to refine strategy and demonstrate its ability to execute its mission.⁴⁷

The absence of large-scale exercises forced units to conduct local exercises with a much narrower scope and a focus on procedures and tasks versus true operational proficiency.⁴⁸ These exercises in the bomber force mainly involved pulling some weapons from storage, loading them on an aircraft, downloading them, and returning them to storage.⁴⁹

Thus, the lack of large-scale exercises in the bomber force had a corrosive effect on operational proficiency, encouraged complacency, and fostered a culture that viewed the nuclear mission as an exercise activity and not a true operational activity.⁵⁰ The following B-52 aircraft commander's comment reflected this assessment: "The nuclear mission is all about procedures; the conventional mission is about operational results."⁵¹

Third, USSTRATCOM inspectors had not observed an inspection in five years, which coincides with the beginning of USSTRATCOM's mission growth in 2002.⁵² Inspections serve the same purposes as local evaluation programs—assess proficiency and ensure compliance and readiness.⁵³ Inspections also provide a venue for evaluating training and exercise programs and providing feedback. USSTRATCOM's inspector general's office was unable to observe inspections due to a combination

⁴⁷ Christopher T. Kuklinski (Chief, Nuclear Concepts and Strategy Division, US Strategic Command, Offutt AFB, NE), phone interview by the author, 14 April 2011; Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35.

⁴⁸ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁴⁹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁵⁰ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁵¹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁵² DSB Task Force on Nuclear Deterrence Skills, *Report*, 37; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 34.

⁵³ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35.

of lack of resources, emphasis on other missions, and a decreased focus on the nuclear mission.⁵⁴

Thus, USSTRATCOM did not observe the fact that Air Force NSI results had “hit an all-time low” in 2003 with only a 50 percent pass rate.⁵⁵ USSTRATCOM also failed to notice the inadequacy of the Air Force’s inspection regime to detect many of the problems that led to the Bent Spear or truly validate a unit’s operational readiness.⁵⁶

Finally, USSTRATCOM failed to object to the practice of conducting inspections according to a published schedule and infrequent interval.⁵⁷ This practice reinforced the perception that the nuclear mission was an exercise activity by encouraging units to adopt a repeated cycle of rigorous inspection preparation followed by an extended stand down period, instead of constant readiness.⁵⁸

Normal Accidents School

This section examines the counterclaims made by the normal accidents school regarding culture, decentralization, and continuous operations as they apply to the Bent Spear and USSTRATCOM. First, the normal accidents school argues that interactive complexity requires decentralized decision-making authority, but tightly coupled systems demand highly centralized decision-making.⁵⁹ Therefore, if a system has both high interactive complexity and tight coupling, neither strict centralization nor decentralization can ensure safety.⁶⁰ Recall that tight

⁵⁴ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 34.

⁵⁵ Michael Hoffman, “Nuclear Safety Slipped for Years Before Minot,” *Air Force Times*, 26 February 2008; Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 36.

⁵⁶ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 6; Michael Hoffman, “Nuclear Safety Slipped for Years Before Minot,” *Air Force Times*, 26 February 2008; Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35-37.

⁵⁷ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 27, 36-37.

⁵⁸ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 27, 36-37.

⁵⁹ Sagan, *Limits of Safety*, 40.

⁶⁰ Sagan, *Limits of Safety*, 40.

coupling did not apply to the Bent Spear. In this case, per the normal accidents school's argument, the tactical ferry missions did not require highly centralized decision-making. Even if tight coupling had applied, the high reliability school claims it is possible to simultaneously have both centralized and decentralized decision-making in systems with high interactive complexity and tight coupling.⁶¹ The school cites aircraft carrier operations as an example where this successfully occurs, enabled by the shared values gained through intense socialization and personnel proficiency from continuous operations.⁶² Again, there is no indication that USSTRATCOM fostered these characteristics, either before or around the time of the Bent Spear.

The balance between centralized versus decentralized authority is an issue for any military C2 system as it deals with uncertainty in the operating environment.⁶³ Nuclear weapons require a high level of centralized control due to their political and military importance, destructive power, and the unacceptable costs associated with any accidental or unauthorized acts.⁶⁴ The fact that only the president can authorize the employment of nuclear weapons clearly illustrates this requirement.⁶⁵

Two watchwords in nuclear operations represent the centralized control requirement—nuclear surety and positive control. Positive control refers to those measures that ensure the receipt and proper execution of presidential orders.⁶⁶ Nuclear surety “is the materiel, personnel, and procedures that contribute to the safety, security,

⁶¹ Sagan, *Limits of Safety*, 47.

⁶² Sagan, *Limits of Safety*, 45-47.

⁶³ See for instance, Martin L. Van Creveld, *Command in War*, (Cambridge, MA: Harvard University Press, 1985), 268, 274.

⁶⁴ See paragraph 4.2.1., DOD Directive (DODD) 3150.2, *DOD Nuclear Weapons System Safety Program*, 23 December 1996, 2.

⁶⁵ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 1.

⁶⁶ Robert D. Critchlow, *Nuclear Command and Control: Current Programs and Issues*, (Washington, DC: Congressional Research Service, The Library of Congress, 3 May 2006), 6.

reliability, and control of nuclear weapons, thus assuring no nuclear accidents, incidents, unauthorized use, or degradation in performance.”⁶⁷ Clearly, the Bent Spear, meaning a “significant incident,” qualified as a nuclear surety violation.⁶⁸

Though centrally controlled by necessity, even nuclear operations require a balance between centralized and decentralized decision-making authority. Operational-and tactical-level personnel must have the necessary authority to take needed actions in order to comply with presidential directives. Again, the weapons handlers and crews involved in the Bent Spear had abundant decentralized decision-making authority, but this was not the main problem. Rather, the main problem was the abundance of decentralized authority without the required reinforcement from a high reliability culture and continually practiced operations. The lack of appropriate local supervision was a key part of this problem.⁶⁹ Similarly, but at a higher level, USSTRATCOM delegated too much authority to the force providers without verifying they had the proper culture and continuous operations to support it.⁷⁰

Second, the normal accidents school claims that leaders often do not know enough to provide guidance as to how lower-level personnel should respond in all situations, which hinders the development of a high reliability culture.⁷¹ In addition, the school claims that if the decision premises and assumptions given to lower-level personnel do not fit the situation, then the uniform responses expected from them may

⁶⁷ Office of the Deputy Assistant to the Secretary of Defense for Nuclear Matters, “Nuclear Surety,”

<http://www.acq.osd.mil/ncbdp/nm/nuclearweaponssurety.html#safety>.

⁶⁸ Air Force Policy Directive (AFPD) 91-1, *Safety: Nuclear Weapons and Systems Surety*, 13 February 2007, 3.

⁶⁹ DoD IG, *Oversight of the Investigation*, 5, in Senate, *Air Force Nuclear Security*, 35.

⁷⁰ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 55.

⁷¹ Sagan, *Limits of Safety*, 40.

decrease safety.⁷² Obviously, no leader can foresee all contingencies, but leaders of organizations that handle hazardous technologies have a responsibility to shape the organization's culture to handle the technologies as safely as possible. Even if leaders could foresee all contingencies, no organization has unlimited resources to address them all, but leaders still need to provide a common set of decision premises and assumptions to lower-level personnel.

The decision premises and assumptions provided to the personnel directly involved in the Bent Spear remain unclear. Perhaps the clearest expression of the desired premises and assumptions come from the procedures in use at the time. In this case, the procedures, as seen in "verify which payload is installed," stressed the importance of pulling the correct ACM pylons for the mission from storage and loading them on the aircraft.⁷³ The requirement for four separate payload verifications by the various weapons handlers and crews was perhaps an acknowledgment that a mix up could occur, given the mixed storage of the various types of ACMs.⁷⁴ However, based on the personnel's failure to verify the payload properly and confusion over what their procedures required, one could see that either the personnel did not understand this acknowledgment or perhaps they disregarded it due to complacency.⁷⁵ If the reason for non-compliance was from a lack of understanding, this again would indicate that socialization and training did not ensure the personnel understood that a mix up could occur. If this were the case, then they would not know why it was so important for them to conduct their verifications properly. Knowing *why* a checklist step is necessary requires a deeper understanding than merely how to comply. Sadly, it appears the personnel understood neither how to comply nor why it was necessary,

⁷² Sagan, *Limits of Safety*, 40-41.

⁷³ Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

⁷⁴ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 2-3.

⁷⁵ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

or again, perhaps they understood, but disregarded what they had learned due to complacency.⁷⁶

The normal accidents school's final counterclaim concerning culture is that the intense socialization and conformity required to develop a high reliability culture will often fail due to incompatibility with individualistic and democratic societal values.⁷⁷ The claim in this instance mainly applies to civilian settings, not the military, as seen in the area of agreement between the two schools about the ideal military model.⁷⁸ I evaluate the degree to which the organizations involved in the Bent Spear matched the ideal military model below, under area of agreement.

Third, the normal accidents school claims that continually practiced operations yield limited benefits, because organizations cannot practice unimagined scenarios that sometimes occur.⁷⁹ It is true that organizations cannot practice unimagined scenarios, but in the Bent Spear case, one can see anticipation of a possible mix up in the type of ACMs to load in the requirement for redundant personnel payload verifications. However, there is no evidence that responsible leaders augmented any anticipated mix up with actual practice of the scenario that occurred in the Bent Spear.

Furthermore, the school claims organizations rarely, if ever, practice extremely dangerous operations due to the fact they are so

⁷⁶ Some common-sense assumptions could have improved safety and possibly prevented the Bent Spear, if explicitly communicated to lower-level personnel through socialization and training. First, always assume the pylons contain nuclear missiles until physically verified otherwise—the same way anyone handling a gun should always assume it is loaded. Second, never assume that remaining unchecked missiles in a pylon are non-nuclear simply because one or more of the six missiles on the pylon are non-nuclear. Finally, based on the trust but verify principle, never assume that prior persons or crews checked the payload status properly.

⁷⁷ Sagan, *Limits of Safety*, 41, 46.

⁷⁸ Sagan, *Limits of Safety*, 50.

⁷⁹ Sagan, *Limits of Safety*, 41.

dangerous.⁸⁰ This statement may also be true, but in the Bent Spear case, there was no evidence of extreme danger in the planned mission. Instead, the evidence points to a routine operation.

Finally, the normal accidents school claims organizations that find themselves in a politicized environment will likely shun politically distasteful scenarios.⁸¹ This statement may also be true, but based on the evidence it is very difficult to say with any certainty how relevant this claim was in the Bent Spear mishap. Nevertheless, one can clearly see that leaders at multiple military and political levels increasingly shunned the nuclear mission throughout the period leading up to the Bent Spear, which led to doing as little as possible with nuclear weapons.⁸² This view was evident in the Air Force's self-described caretaker approach and the bomber leg's view of the nuclear mission as an exercise activity and not a true operational mission.⁸³ As for USSTRATCOM, its limited purview and lack of oversight and support also encouraged a minimalist approach toward nuclear weapons that failed to ingrain within the personnel the need to check every missile, every time.

Area of Agreement

There are two areas of agreement between the two schools with regard to this factor. First, the normal accidents school agrees in principle that continually practiced operations can help improve safety, but claims the effects are limited for the reasons noted.⁸⁴ In addition, in *The Limits of Safety*, Sagan identified an ongoing tension in SAC between the warrior culture and need for readiness on one hand, and the need for

⁸⁰ Sagan, *Limits of Safety*, 41.

⁸¹ Sagan, *Limits of Safety*, 41.

⁸² DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 15-19; DSB Task Force on Nuclear Deterrence Skills, *Report*, vi-vii, 14-15, 59.

⁸³ Department of the Air Force, *Reinvigorating the Air Force Nuclear Enterprise* (Washington, DC: Air Force Nuclear Task Force, 24 October 2008), 1; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁸⁴ Sagan, *Limits of Safety*, 41.

a culture of safety and safe operations on the other.⁸⁵ He predicted that this tension between nuclear safety and readiness would continue.⁸⁶ The events of the Bent Spear point to a different tension between nuclear safety and the absence of readiness, exemplified by the lack of continually practiced operations and an exercise culture versus a highly operational culture. The complacency that naturally resulted from the absence of readiness or caretaker approach worked against the continuing need for safety.

Furthermore, there is ample evidence that no tension exists between readiness and safety. For example, the high reliability school cited the fact that the likelihood of air traffic control accidents increased in times of low traffic rather than high traffic, due to lower vigilance.⁸⁷ Likewise, the school found that constant flight training on aircraft carriers was critical to their superb safety record.⁸⁸ Similarly, the Air Force's efforts to improve the realism and frequency of training in the post-Vietnam era produced combat-ready pilots and an unanticipated safety windfall.⁸⁹ The mishap rate per 100,000 flying hours dropped by half, from 2.8 to 1.4, between 1975 and 1995.⁹⁰ Thus, there is no reason to view the goals of readiness and safety as incompatible. The Bent Spear reinforced this assessment, because it occurred in the bomber leg of the triad, which was the only leg taken off alert and saw the greatest decline in culture, continuous training, and loss of focus on the nuclear mission.⁹¹

⁸⁵ Sagan, *Limits of Safety*, 271-72.

⁸⁶ Sagan, *Limits of Safety*, 272.

⁸⁷ Sagan, *Limits of Safety*, 24.

⁸⁸ Sagan, *Limits of Safety*, 24.

⁸⁹ Benjamin S. Lambeth, *The Transformation of American Air Power*, (Ithaca, NY: Cornell University Press, 2000), 70-71.

⁹⁰ Lambeth, *Transformation of American Air Power*, 71.

⁹¹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7-9, 11-15; Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 55.

The two schools also agree that the ideal military model, characterized by isolation from society, intense socialization, and strict discipline, can enhance safety by fostering a culture of reliability.⁹² If Sagan's 1993 assessment that the military organizations that control nuclear weapons were designed to "come as close as possible to that idealized military model" was accurate, it certainly no longer applied to the bomber leg by the time of the Bent Spear.⁹³ Lack of daily alert and a shift to a conventional focus meant a lack of isolation, socialization, exacting standards, and continuous nuclear training to foster and maintain a culture of reliability.⁹⁴

No military organization perfectly matches the ideal military model, but those in the other two legs of the triad—the Air Force's ICBM units and to a greater extent the Navy's nuclear ballistic missile submarines—came closer than those in the bomber leg. In this regard, a clear mission, corresponding focus, and continually practiced operations seem critical. As discussed, USSTRATCOM did not help the Air Force and Navy develop and sustain high reliability cultures due to its own lack of focus and oversight, inadequate exercises and procedural reviews, and non-existent inspection observations.

Corrective Actions and Assessment

USSTRATCOM improved its posture with regard to this factor through various actions in the areas of procedures, exercises, and inspections, in addition to other previously discussed improvements in oversight, active force monitoring, and resource advocacy. First, USSTRATCOM improved procedural review and oversight for areas under its purview. In order to have effective decentralized decision-making, lower-level personnel must have clear, accurate, and current guidance.

⁹² Sagan, *Limits of Safety*, 50.

⁹³ Sagan, *Limits of Safety*, 50.

⁹⁴ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7-9, 11-15; Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 2, 18, 21-22, 27, 33, 35, 55-56; Senate, *Air Force Nuclear Security*, 8.

USSTRATCOM asserted more control over the process and began issuing guidance on a more predictable basis.⁹⁵ For instance, it directed annual October revisions to all publications instead of on a piecemeal basis, which made it easier for operational units to update lesson plans and provide training to personnel.⁹⁶ It also established teams to interface directly with operational units to rewrite procedures, eliminated arcane checklist steps, and helped limit the amount of interim guidance and clarification messages.⁹⁷

Second, in the area of exercises, USSTRATCOM showed substantial improvement. After having no major, end-to-end nuclear exercises since 1995, it held one in June 2009 and two more in 2010.⁹⁸ The June 2009 Global Thunder exercise “demonstrated the full range of nuclear deterrence capabilities by integrating submarine strategic deterrent patrols, more than 90 aircraft sorties, an ICBM test launch, and five days of continuous airborne command-and-control operations.”⁹⁹ In addition to demonstrating readiness and enhancing proficiency, these exercises give USSTRATCOM the opportunity to refine deterrence strategy.¹⁰⁰

Third, after going five years without observing an inspection, General Chilton reinstated the practice shortly after taking command at USSTRATCOM.¹⁰¹ Since then, its inspectors have observed every Air

⁹⁵ Brown, phone interview.

⁹⁶ Brown, phone interview.

⁹⁷ Brown, phone interview.

⁹⁸ Senate Committee on Armed Services, *Statement of General Kevin P. Chilton, Commander, United States Strategic Command*, 111th Cong., 2d sess., 24 March 2010, 3; Kuklinski, phone interview.

⁹⁹ Senate Committee, *Statement of General Kevin P. Chilton*, 3.

¹⁰⁰ Senate Committee, *Statement of General Kevin P. Chilton*, 3; Kuklinski, phone interview.

¹⁰¹ Michael Hoffman, “New Focus on Nukes – Exclusive Interview: Leader Spells Out StratCom’s Plans to Support Air Force Mission,” *Air Force Times*, 13 October 2008.

Force and Navy nuclear inspection.¹⁰² The inspectors do not inspect the units themselves, but rather monitor the inspectors, provide oversight, and provide feedback to USSTRATCOM leaders.¹⁰³

Although USSTRATCOM made substantial gains in these areas, there is room for improvement. For example, USSTRATCOM now observes all nuclear inspections, but it sends only one observer.¹⁰⁴ It is hard to imagine how one person can adequately observe the actions of up to 100 inspectors in some cases, especially if they disperse across a vast missile field, as required for ICBM inspections.¹⁰⁵

In the area of procedures, USSTRATCOM's oversight and review does not extend beyond operations, to procedures for maintenance and other mission support activities. The lack of procedural oversight for these areas is in keeping with its planning, targeting and employment responsibilities.¹⁰⁶ One needs to recognize the distinction here between USSTRATCOM's oversight as far as force monitoring and tracking the maintenance status of an off-alert ICBM, for example, which USSTRATCOM does, versus oversight of the actual procedures used by the maintainers.¹⁰⁷ Of course, to provide procedural oversight for all aspects of the nuclear mission, USSTRATCOM would require more resources and expertise than it has currently.

¹⁰² Gen Kevin P. Chilton, commander, US Strategic Command (address, Air Force Association Convention, Orlando, FL, 26 February 2009); Brown, phone interview.

¹⁰³ Michael Hoffman, "New Focus on Nukes – Exclusive Interview: Leader Spells Out StratCom's Plans to Support Air Force Mission," *Air Force Times*, 13 October 2008; Gen Kevin P. Chilton, commander, US Strategic Command (address, Air Force Association Convention, Orlando, FL, 26 February 2009).

¹⁰⁴ Col Heraldo B. Brual, commander, Air Force Inspection Agency, to the author, e-mail, 24 March 2011.

¹⁰⁵ Adam J. Hebert, "Strike Command Steps Up," *Air Force Magazine* 93, no. 6 (June 2010): 29.

¹⁰⁶ United States Strategic Command, "History," <http://www.stratcom.mil/history>.

¹⁰⁷ Michael G. Vaughn (Contractor, US Strategic Command, Offutt AFB, NE), phone interview by the author, 7 April 2011—Col Vaughn, USAF, retired, was STRAT/J38 (Chief, Nuclear Operations and C2 Division) from June 2008-December 2010.

Finally, despite USSTRATCOM's improved exercise program, it remains difficult to provide challenging on-going nuclear operations in the bomber leg without daily alert. Thus, personnel must gain proficiency primarily through exercises and simulations. The task is more difficult because Barksdale AFB still does not have its own weapons storage area.¹⁰⁸ Therefore, Barksdale crews and B-52s must continue to fly to Minot AFB for training on a regular basis.¹⁰⁹ In short, USSTRATCOM now takes a more active role in fostering the proper culture in the nuclear forces through improvements in operations, oversight, and appropriate delegated authority. However, many problems remain and will require a sustained commitment to further improvements in order to maximize its safety posture.

Clearly, the high reliability school places great emphasis on culture, decentralization, and continuous operations, but it claims organizations also need sophisticated forms of trial and error learning to augment this third factor. The next chapter explores trial and error learning from the perspectives of both schools, examines its role in the Bent Spear and USSTRATCOM's posture in relation to it, and assesses whether corrective actions have improved USSTRATCOM's safety posture.

¹⁰⁸ Air Force Association, "No Weapons Storage Area for Barksdale," AirForce-Magazine.com, 23 February 2011, <http://www.airforce-magazine.com/DRArchive/Pages/2011/February%202011/February%2023%202011/NoWeaponsStorageAreaforBarksdale.aspx>.

¹⁰⁹ Air Force Association, "No Weapons Storage Area for Barksdale," AirForce-Magazine.com, 23 February 2011, <http://www.airforce-magazine.com/DRArchive/Pages/2011/February%202011/February%2023%202011/NoWeaponsStorageAreaforBarksdale.aspx>.

Chapter 6

Trial and Error Learning

How did we allow our adherence to nuclear codes of conduct to erode to this point? Of greatest concern to me is how we ensure the events of August 2007 do not happen again.

Senator John Warner

This chapter's purpose is to evaluate USSTRATCOM's use of trial and error learning at the time of the 30 August 2007 Minot Bent Spear, and to assess how much improvement has been made in this area since that time. The chapter begins with an overview of the high reliability school's claims about the importance of trial and error learning. Next, I cover the counterclaims made by the normal accidents school for this factor. These sections summarize the arguments from the two competing schools about this factor in Sagan's *The Limits of Safety*. Unlike the other factors, there is no apparent area of agreement between the two schools, regarding trial and error learning, so I skip this point in this section. I use the same pattern of analysis from previous chapters to evaluate USSTRATCOM's use of trial and error learning at the time of the Bent Spear and to assess USSTRATCOM's current safety posture.

High Reliability School Perspective

The final factor the high reliability school claims is necessary for extremely safe operations in organizations that handle hazardous technologies is the ability to learn through a sophisticated trial and error process.¹ The school stresses the need for such organizations to adjust their activities, as, through trial and error, they learn what practices

¹ Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton, NJ: Princeton University Press, 1993), 25.

enhance safety and what practices do not.² In addition, the school emphasizes the need for calculated trial and error to help identify unknown risks and develop personnel and organizational coping skills for dealing with such risks at a low level when they arise.³ This process augments learning from normal operations by actively seeking out small dangers in order to decrease the risk from big ones.⁴

The high reliability school also cites the need for added sophistication through anticipation and simulations, due to the high cost of accidents in hazardous technology industries.⁵ The school cites simulated crisis training for airline pilots, air traffic controllers, aircraft carrier crews, and nuclear power plant operators as examples of how personnel can experience realistic trials in a controlled environment.⁶ Sometimes outside consultants can help analyze risk, identify hidden faults, and identify solutions.⁷ In essence, organizations can speed up the learning process through simulations and anticipation.⁸

Normal Accidents School Perspective

Based on its view of organizations, the normal accidents school argues effective organizational learning is rare.⁹ The school holds this view for a number of reasons.¹⁰ First, when mishap causes are unclear, biased reconstruction of history by organizational leaders will limit learning efforts.¹¹

Second, the school claims that mishap analysis that occurs in politicized environments tends to hinder learning efforts, by assigning

² Sagan, *Limits of Safety*, 25.

³ Sagan, *Limits of Safety*, 26.

⁴ Sagan, *Limits of Safety*, 26.

⁵ Sagan, *Limits of Safety*, 26.

⁶ Sagan, *Limits of Safety*, 26-27.

⁷ Sagan, *Limits of Safety*, 27.

⁸ Sagan, *Limits of Safety*, 27.

⁹ Sagan, *Limits of Safety*, 41.

¹⁰ Sagan, *Limits of Safety*, 41.

¹¹ Sagan, *Limits of Safety*, 41-42.

blame to expendable members of the organization and protecting the most powerful actors as well as the organization itself.¹² This helps explain why internal investigations often cite operator error as the cause of many mishaps, instead of flawed system design and/or poor senior management decisions.¹³

Third, faulty reporting based on cover-ups and fabrication thwarts learning efforts and the ability to analyze mishaps accurately.¹⁴ This phenomenon connects to the second claim, because lower-level personnel have great incentives to avoid blame, by covering up their errors, if they feel the investigation process is unfair.¹⁵ The school also claims cover-ups occur by organizational leaders, to protect the organization's image and minimize external criticism.¹⁶

Finally, the normal accidents school claims that secrecy inside and between organizations will constrain organizational learning.¹⁷ Although there are good reasons for secrecy, internal secrecy, in the form of compartmented knowledge, limits the broad organization's learning ability.¹⁸ Meanwhile, external secrecy between organizations limits vicarious learning.¹⁹

As noted, there is no evident area of agreement between the two schools with regard to trial and error learning. However, it is apparent that the two schools are addressing this factor primarily from two different temporal perspectives. The high reliability school's emphasis is primarily on proactive efforts to promote organizational learning, through sophisticated trial and error efforts, in order to help prevent mishaps. In contrast, the normal accidents school's emphasis is on reactive efforts

¹² Sagan, *Limits of Safety*, 42.

¹³ Sagan, *Limits of Safety*, 42.

¹⁴ Sagan, *Limits of Safety*, 42.

¹⁵ Sagan, *Limits of Safety*, 42.

¹⁶ Sagan, *Limits of Safety*, 42.

¹⁷ Sagan, *Limits of Safety*, 42.

¹⁸ Sagan, *Limits of Safety*, 42.

¹⁹ Sagan, *Limits of Safety*, 42.

that hinder organizational learning after mishaps occur. This difference in perspectives may explain some of the divergence between the two schools with respect to this factor.

Bent Spear and USSTRATCOM's Use of Trial and Error Learning

Having covered the differing perspectives of the two competing schools, as well as their area of agreement, I now evaluate USSTRATCOM's use of trial and error learning around the time of the Bent Spear. My evaluation proceeds from the lens of the high reliability school to the normal accidents school.

High Reliability School

The high reliability school stresses the need for organizations to learn through trial and error what practices enhance safety and what practices do not.²⁰ The bomber leg of the triad (in particular the B-52 portion) had the opportunity to learn this from several decades of operations. Trial and error learning was evident when the DoD halted the practice of continual airborne alerts for nuclear bombers in 1968 after 27 crashes from 1950 to 1968 involving aircraft with nuclear weapons.²¹ The Air Force was limited to ground alert for nuclear-armed bombers from 1968 until September 1991 when President George H. W. Bush halted that practice as well.²²

As was the case with continually practiced operations, problems with a lack of trial and error learning in the nuclear bomber force go back to the decision to halt day-to-day nuclear bomber alert.²³ The absence of daily nuclear alert limited learning efforts, by removing a

²⁰ Sagan, *Limits of Safety*, 25.

²¹ Michael Hoffman, "Officials Red-faced Over Nuke Error – Congress Seeks Explanation of How B-52 Carried Warheads," *Air Force Times*, 17 September 2007.

²² Lawrence Freedman, *The Evolution of Nuclear Strategy*, 3rd ed. (New York: Palgrave Macmillan, 2003), 422-23.

²³ Defense Science Board Task Force on Nuclear Weapons Surety, *Report on the Unauthorized Movement of Nuclear Weapons* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, April 2008), 15; Senate, *Air Force Nuclear Security: Hearing before the Committee on Armed Services*, 110th Cong., 2d sess., 12 February 2008, 8.

primary source of feedback about mission performance. The decision also limited the opportunity to improve safety by learning and incorporating new lessons into existing procedures and training programs. Also, many of the lessons learned from decades of experience gained from performing the nuclear mission on a daily basis atrophied along with proficiency levels, as the focus shifted to conventional operations.²⁴ Evidently, one such lesson was that the mixed storage of nuclear and non-nuclear weapons was a bad idea, because the Air Force prohibited it until at least 1992.²⁵

Some of the procedures may have survived from the earlier decades of learning. However, the Bent Spear illustrated that the personnel involved either disregarded or modified procedures without proper review or did not understand how or why they needed to comply with the procedures.²⁶ For instance, in order to expedite the ACM movement process, the breakout and convoy crews changed the procedures for initial status verification and pylon trailer tow preparation.²⁷ Instead of doing the actions sequentially, as required, the crews disregarded established procedures and performed them concurrently.²⁸

The changes for how to distinguish nuclear-inert ACMs provide another example of changes to established procedures or requirements that “occurred without adequate review and approval above the wing level.”²⁹ Instead of identifying such ACMs with placards on multiple sides of the pylon and orange cones around it, the practice changed over

²⁴ Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase I Report: The Air Force’s Nuclear Mission* (Arlington, VA: September 2008), 3, 22-23, 52; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

²⁵ Michelle Spencer, Aadina Ludin, and Heather Nelson, *The United States Air Force Minot and Taiwan Nuclear Weapons-Related Incidents: An Assessment*, (Maxwell AFB, AL: Air University, March 2011), 8.

²⁶ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

²⁷ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

²⁸ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

²⁹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

time to simply placing one 8 x 10 in. piece of paper somewhere on the pylon and no orange cones.³⁰ Furthermore, the widespread confusion about the checklist requirement to “verify which payload is installed,” indicates the personnel did not understand how or why they needed to comply with the procedure.³¹ These changes reflected the broadly perceived devaluing and loss of focus on the nuclear mission throughout the DoD around the time of the Bent Spear.³²

In addition, the high reliability school emphasizes the need to augment learning by actively seeking out small dangers through calculated trial and error in order to decrease the risk from big dangers and help deal with risks at a low level.³³ However, the prevailing attitude toward nuclear weapons throughout the period leading up to the Bent Spear was clearly not consistent with the high reliability school in this case. In fact, the conventional mission dominated nuclear mission preparation to such an extent that only the restricted area, where nuclear weapons are maintained and stored, saw daily attention on the nuclear mission.³⁴ Granted, no one should expose nuclear weapons to even small dangers or intentionally deviate from established procedures.³⁵ However, the activities associated with nuclear weapons in

³⁰ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

³¹ Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 5.

³² DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7, 9, 11-19; Defense Science Board Task Force on Nuclear Deterrence Skills, *Report* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, September 2008), vi-vii, 15, 59; Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 22-23, 29-32; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase II Report: Review of the DoD Nuclear Mission* (Arlington, VA: December 2008), Chairman’s Opening Letter, 55; Department of Defense, *Nuclear Posture Review Report* (Washington, DC: April 2010), 43.

³³ Sagan, *Limits of Safety*, 26.

³⁴ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12-13.

³⁵ See paragraph 4.2.9., DOD Directive (DODD) 3150.2, *DOD Nuclear Weapons System Safety Program*, 23 December 1996, 3.

the bomber leg did not allow for even a modicum of proactive trial and error learning to occur.³⁶

The bomber community provides additional evidence of the atrophy in learning as expected from the high reliability school's approach to safety. For example, neither the B-52 initial training, nor the advanced weapons school courses had flying sorties devoted to the nuclear mission.³⁷ By 2007, most bomber personnel had never experienced nuclear alert, and most of the B-52 aircrews and weapons handlers estimated they spent only about 5 to 20 percent of their time on the nuclear mission.³⁸ The normal exercise in the bomber force involved pulling some weapons from storage, loading them on an aircraft, downloading them, and returning them to storage.³⁹ Clearly, the Air Force's caretaker approach, coupled with USSTRATCOM's limited purview and lack of oversight and support encouraged a minimalist approach toward nuclear weapons.⁴⁰

Furthermore, the high reliability school cites the need for added sophistication through anticipation and simulations due to the high cost of accidents in hazardous technology industries.⁴¹ There is no evidence that these actions occurred around the time of the Bent Spear. Exercises provide an excellent forum in which to conduct simulations. However, no major, end-to-end nuclear exercise had occurred since 1995.⁴² The absence of large-scale exercises forced units to conduct local exercises

³⁶ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

³⁷ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12-13.

³⁸ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11-12.

³⁹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁴⁰ Department of the Air Force, *Reinvigorating the Air Force Nuclear Enterprise* (Washington, DC: Air Force Nuclear Task Force, 24 October 2008), 1; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 11; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 55.

⁴¹ Sagan, *Limits of Safety*, 26.

⁴² Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35, C-4.

with a much narrower scope and a focus on procedures and tasks instead of true operational proficiency and enhanced learning.⁴³

If either the Air Force or USSTRATCOM had promoted organizational learning through sophisticated trial and error efforts, perhaps the organizations responsible for the Bent Spear could have learned or relearned something valuable that could have prevented the incident. For instance, if they had relearned before the Bent Spear that mixed weapons storage allowed unnecessary access to nuclear weapons, they could have prevented the mix up that helped cause the Bent Spear.⁴⁴

Normal Accidents School

The normal accidents school provides insights into several impediments that hinder organizational learning. However, these impediments seem to have little applicability to the Bent Spear case. First, this school claims when mishap causes are unclear, biased reconstruction of history by organizational leaders will limit learning efforts.⁴⁵ There is no indication the causes of the Bent Spear were unclear. Air Combat Command's (ACC's) investigating officer found root causes at two levels. At the unit level, he found breakdowns in leadership and discipline at Barksdale AFB and Minot AFB.⁴⁶ At the institutional level, he found a decline in focus on the nuclear bomber mission.⁴⁷ In testimony before the Senate Armed Services Committee, Air Force leaders gave several reasons for the decline in focus that they traced back to 1991 and the end of the Cold War and the decision to end daily nuclear alert.⁴⁸ In addition to the loss of operational proficiency

⁴³ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 35; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁴⁴ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 6.

⁴⁵ Sagan, *Limits of Safety*, 41-42.

⁴⁶ Senate, *Air Force Nuclear Security*, 8.

⁴⁷ Senate, *Air Force Nuclear Security*, 8.

⁴⁸ Senate, *Air Force Nuclear Security*, 8.

from the absence of alerts, they also cited increased conventional commitments, operational tempo, and “a continuously-shrinking force” as reasons for the decline in focus.⁴⁹ The DoD Inspector General’s office, which conducted oversight of the ACC investigation at the request of the Senate Armed Services Committee chairman and the secretary of the Air Force, upheld these findings.⁵⁰ Therefore, the normal accidents school’s first claim does not apply to the Bent Spear.

Second, the school claims political motivations often hinder learning efforts by encouraging scapegoating during mishap analysis, to protect organizational elites and the organization itself.⁵¹ The many Bent Spear investigations revealed that there was plenty of blame to go around for the incident. For example, the ACC investigation did assign blame to lower-level personnel who failed to follow established procedures, but it also assigned blame to their supervisors and commanding officers and to the Air Force as an institution for the decline in focus.⁵² As a result of the ACC investigation, the Air Force temporarily decertified 90 personnel, removed two personnel from instructor or evaluator positions, disciplined 13 for *Uniform Code of Military Justice* violations, and removed 15 from command or supervisory positions.⁵³ The removals included one wing and two group commanders as well as lower-level supervisors.⁵⁴

To address the institutional decline in focus adequately, the ACC investigating officer recommended a DoD-level review and an Air Force

⁴⁹ Senate, *Air Force Nuclear Security*, 8.

⁵⁰ Department of Defense Inspector General, *Oversight of the Investigation Directed by the Commander, Air Combat Command Concerning an Unauthorized Transfer of Classified Material from Minot Air Force Base, North Dakota to Barksdale Air Force Base, Louisiana on August 30, 2007*, (Washington, DC: 8 February 2008), 1, 8, in Senate, *Air Force Nuclear Security: Hearing before the Committee on Armed Services*, 110th Cong., 2d sess., 12 February 2008, 31, 38.

⁵¹ Sagan, *Limits of Safety*, 42.

⁵² DoD IG, *Oversight of the Investigation*, 1, 5, in Senate, *Air Force Nuclear Security*, 31, 35; Senate, *Air Force Nuclear Security*, 8.

⁵³ DoD IG, *Oversight of the Investigation*, 8, in Senate, *Air Force Nuclear Security*, 38; Senate, *Air Force Nuclear Security*, 8.

⁵⁴ Senate, *Air Force Nuclear Security*, 8.

blue ribbon panel review.⁵⁵ These, and subsequent investigations, revealed systemic problems associated with a loss of focus on the nuclear mission throughout the DoD.⁵⁶ After Admiral Donald's investigation highlighted systemic Air Force problems that led to both the Bent Spear and the mistaken Taiwan shipment, the secretary of defense forced both the Air Force chief of staff and secretary to resign.⁵⁷ Thus, although the Air Force did not initiate all of the investigations and reports in the aftermath of the Bent Spear, one would have to distort the facts to suggest it engaged in scapegoating.⁵⁸

In contrast to the Air Force's actions, General Chilton claimed, as late as October 2008, that USSTRATCOM had not lost its focus on the nuclear mission, and that problems had been isolated to the Air Force.⁵⁹ This claim directly contradicted the previously published findings of the Defense Science Board Task Force on Nuclear Weapons Surety and the later findings of the Task Force on DoD Nuclear Weapons Management.⁶⁰ In short, although both the Air Force and USSTRATCOM acted in politicized environments in the aftermath of the Bent Spear, the Air Force did little to protect its elites and itself from blame, while USSTRATCOM attempted to deflect blame despite ample contradictory evidence.

Third, the normal accidents school claims lower-level personnel trying to avoid blame, and organizational leaders trying to protect the

⁵⁵ Senate, *Air Force Nuclear Security*, 13.

⁵⁶ Senate, *Air Force Nuclear Security*, 2, 8-9; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7, 9-19; DSB Task Force on Nuclear Deterrence Skills, *Report*, vi-vii, 15, 59; Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 22-23, 29-32; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, Chairman's Opening Letter, 55; Department of Defense, *Nuclear Posture Review Report*, 43; Department of Defense, *Transcript: DoD News Briefing with Secretary Gates from the Pentagon* (Washington, DC: Office of the Under Secretary of Defense for Public Affairs, 5 June 2008), 2.

⁵⁷ Department of Defense, *DoD News Briefing with Secretary Gates*, 2-3.

⁵⁸ Department of Defense, *DoD News Briefing with Secretary Gates*, 2-3.

⁵⁹ Michael Hoffman, "New Focus on Nukes – Exclusive Interview: Leader Spells Out StratCom's Plans to Support Air Force Mission," *Air Force Times*, 13 October 2008.

⁶⁰ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7, 9, 11; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 55.

organization's image often frustrate accurate mishap analysis and learning through cover-ups and fabrication.⁶¹ No evidence from the Bent Spear case suggests any of these actions occurred. The Bent Spear was unprecedented—it was the first in USSTRATCOM's history, and nothing suggests another instance of nuclear weapons flying on a bomber's wings without authorization after airborne alerts ended in 1968.⁶² Thus, the personnel involved had nothing else of similar magnitude with which to compare the likely investigation process for the Bent Spear. If the personnel had caught the mistake at Minot AFB, one can imagine that they may have tried to hide their mistake. However, after the aircrew flew the weapons to Barksdale AFB, there was little chance that the personnel involved or their organizational leaders could have successfully covered up such a colossal mistake involving multiple organizations. On the contrary, after discovering the incident, the Air Force promptly reported it to the secretary of defense and president, and the ACC commander initiated an investigation.⁶³

Finally, the normal accidents school claims secrecy inside and between organizations constrains organizational learning internally by compartmenting knowledge and externally by limiting vicarious learning.⁶⁴ Again, these claims may be true in some cases, but the claims do not apply to the Bent Spear specifically. Eight separate investigations and reports have addressed the Bent Spear either directly or indirectly.⁶⁵ Of these, ACC classified its report and the DoD classified

⁶¹ Sagan, *Limits of Safety*, 42.

⁶² Senate, *Air Force Nuclear Security*, 2; Larry Chandler, DTRA contractor, to the author, e-mail, 10 March 2011.

⁶³ Senate, *Air Force Nuclear Security*, 6.

⁶⁴ Sagan, *Limits of Safety*, 42.

⁶⁵ The eight reports are: ACC Commander Directed Investigation, conducted by Major General Raaberg; The DoD IG's oversight and report of the ACC CDI; Admiral Donald's report for the Taiwan shipment and Bent Spear; The Air Force's Blue Ribbon Review, led by Major General Peyer; The DSB Task Force on Nuclear Weapons Surety, led by General Welch (USAF ret.); Secretary of Defense Task Force on DoD Nuclear Weapons Management, Phase I Report on the Air Force's Nuclear Mission; same task force's

Admiral Donald's report, although significant unclassified portions came out later through other forums.⁶⁶ Given the sensitive nature of the weapons, components, and procedures involved in the Bent Spear and mistaken Taiwan shipment, it is reasonable that authorities would classify the reports. However, nothing suggests any effort to withhold the information in these two reports from those within the Air Force and DoD who had a need to know the material. In addition, the six other reports provide ample information about the circumstances and causes of the Bent Spear for anyone interested in this case.

Corrective Actions and Assessment

Thus far, the assessment reveals that the Bent Spear occurred in the absence of an effective learning environment. This was especially true for the bomber leg of the triad, due to the lack of daily alert and the change in focus from nuclear to conventional operations, which greatly limited available learning opportunities.⁶⁷ This section evaluates USSTRATCOM's efforts to provide a better learning environment to support the nuclear mission.

USSTRATCOM's efforts in the areas of exercises and encouraging the reporting of safety deficiencies are most applicable to improving its learning posture. First, in the area of exercises, USSTRATCOM showed substantial improvement by having a major, end-to-end nuclear exercise in June 2009 and two more in 2010.⁶⁸ Going forward, USSTRATCOM

Phase II Report on the DoD's Nuclear Mission, both led by Dr. James Schlesinger; and the Air University research project to assess the United States Air Force Minot and Taiwan Nuclear Weapons-Related Incidents.

⁶⁶ See Senate, *Air Force Nuclear Security*, for excerpts from the ACC investigation, and Department of Defense, *DoD News Briefing with Secretary Gates*, for excerpts from Admiral Donald's report.

⁶⁷ Task Force on DoD Nuclear Weapons Management, *Phase I Report*, 3, 22-23, 52; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 12.

⁶⁸ Senate Committee on Armed Services, *Statement of General Kevin P. Chilton, Commander, United States Strategic Command*, 111th Cong., 2d sess., 24 March 2010, 3; Christopher T. Kuklinski (Chief, Nuclear Concepts and Strategy Division, US Strategic Command, Offutt AFB, NE), phone interview by the author, 14 April 2011.

expects to have one major Global Thunder exercise per year.⁶⁹ These exercises give USSTRATCOM the opportunity to enhance trial and error learning through simulations and challenging scenarios to test and refine seldom-practiced procedures. However, it remains difficult to provide challenging learning opportunities in nuclear operations within the bomber leg without daily alert. The alert posture articulated in the 2010 Nuclear Posture Review continues the status quo indefinitely, so this difficulty shows every sign of persisting.⁷⁰

Second, USSTRATCOM encouraged the reporting and sharing of safety deficiencies or Dull Swords in nuclear surety terms.⁷¹ Dull Swords are safety deficiencies that do not rise to the level of a nuclear incident or accident.⁷² Dull Swords are an excellent way to identify problems at a low level before they become more serious and potentially result in incidents or accidents.⁷³ Thus, historically, the force providers have actively encouraged their nuclear units to report Dull Swords through established channels to fix problems at the lowest level and identify any negative trends for corrective action.⁷⁴

Prior to the Bent Spear, the number of Dull Sword reports in the Air Force suffered a steep decline.⁷⁵ USSTRATCOM encouraged Dull

⁶⁹ Christopher T. Kuklinski, chief, USSTRATCOM Nuclear Concepts and Strategy Division, Offutt AFB, NE, to the author, e-mail, 16 May 2011.

⁷⁰ Department of Defense, *Nuclear Posture Review Report*, 27.

⁷¹ Maj Gen Joseph D. Brown IV (Commandant, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, DC), phone interview by the author, 1 April 2011—Maj Gen Brown was STRAT/J3N from December 2008-October 2010; Air Force Policy Directive (AFPD) 91-1, *Safety: Nuclear Weapons and Systems Surety*, 13 February 2007, 4.

⁷² AFPD 91-1, *Safety*, 4.

⁷³ Michael Hoffman, "Nuclear Safety Slipped for Years Before Minot," *Air Force Times*, 26 February 2008; Maj Gen Frederick F. Roggero, Chief of Safety, Air Force Safety Center, *Nuclear Surety Bulletin*, Kirtland AFB, NM.

⁷⁴ Michael Hoffman, "Nuclear Safety Slipped for Years Before Minot," *Air Force Times*, 26 February 2008; Roggero, *Nuclear Surety Bulletin*.

⁷⁵ Col Daniel M. Vadnais, staff judge advocate, Air Force Safety Center, to the author, e-mail, 16 February 2011. AFSC provided the number of Air Force Dull Swords by year going back to 1998. AFSC advised the author that Dull Swords information is FOUO,

Sword reporting through the force providers by emphasizing the need to report problems in order to fix them at the lowest level.⁷⁶ With USSTRATCOM's encouragement, the number of Dull Sword reports in the Air Force has increased dramatically since 2006, along with their visibility at USSTRATCOM and with senior leaders in the Air Force.⁷⁷

Although the high reliability school calls for a proactive approach to promote organizational learning through sophisticated trial and error efforts, it seems unlikely that USSTRATCOM and the force providers will fully embrace this approach. Thus far, they have primarily emphasized the need to return to a culture of accountability and strict adherence to established procedures.

Instead of seeking out small dangers in a proactive manner, they emphasize the need to fix problems in a timely manner after personnel identify them through normal processes. This approach is better than the minimalist approach toward nuclear weapons that existed around the time of the Bent Spear, but it falls short of the high reliability school ideal. Therefore, USSTRATCOM and the force providers should make the most of every opportunity to conduct simulations during exercises and local training events that go beyond the normal routine to enhance learning.

If mishaps do occur, USSTRATCOM and the force providers should be aware of and minimize reactive efforts that hinder organizational learning that the normal accidents school highlights. In this regard, claims such as General Chilton's in October 2008 that USSTRATCOM had not lost its focus on the nuclear mission, and that problems had

so no specific numbers are used in this study. The Navy would not provide any data on their Dull Swords.

⁷⁶ Brown, phone interview.

⁷⁷ Vadnais to the author, e-mail; Michael G. Vaughn (Contractor, US Strategic Command, Offutt AFB, NE), phone interview by the author, 7 April 2011—Col Vaughn, USAF, retired, was STRAT/J38 (Chief, Nuclear Operations and C2 Division) from June 2008-December 2010; Roggero, *Nuclear Surety Bulletin*.

been isolated to the Air Force, are counterproductive.⁷⁸ Mishaps provide learning opportunities, and organizations should embrace them accordingly, although learning the lessons is often hard.

In this vein, the Bent Spear represents an excellent example of inadvertent trial and error learning. Though the Bent Spear was a significant incident by definition, nothing indicates it posed any serious threat of accidental or unauthorized nuclear detonation or accidental nuclear war or even plutonium dispersal from the W80-1 warheads.⁷⁹ The mission called for inert ACMs, so the crew never powered up the pylons and never armed the missiles.⁸⁰ The missiles were essentially along for the ride on the tactical ferry missions. Clearly, no one should suggest the Bent Spear was somehow a minor incident, but perhaps the best way to view it is as a learning experience.

If one views the Bent Spear as an example of inadvertent trial and error learning, the error of course is the Bent Spear itself. Based on the available evidence, one could describe the trial as how much neglect of the nuclear mission can the organizations responsible for it allow, before they should expect a serious incident to occur.

In hindsight, given the context and the state of the nuclear mission at the time, one can easily see how something like the Bent Spear or a more serious incident could occur. Based on what it learned from the Bent Spear and other incidents, USSTRATCOM took many actions. The next chapter evaluates whether these actions have adequately postured USSTRATCOM to safely conduct the nuclear mission along with other conclusions, implications, and recommendations of this study.

⁷⁸ Michael Hoffman, "New Focus on Nukes – Exclusive Interview: Leader Spells Out StratCom's Plans to Support Air Force Mission," *Air Force Times*, 13 October 2008.

⁷⁹ AFPD 91-1, *Safety*, 3; Senate, *Air Force Nuclear Security*, 71-72.

⁸⁰ Senate, *Air Force Nuclear Security*, 71.

Conclusions

If there is one unchanging, immutable truth, it is that it [the nuclear arsenal] demands constant and undivided attention.

Lt Gen Frank G. Klotz

This chapter begins with a review of the thesis and methodology I used to evaluate whether USSTRATCOM is postured to safely conduct the nuclear mission. Then, I present the conclusions of the study, followed by implications and recommendations from the conclusions. Finally, I present the major lesson from the study followed by a suggested area for future investigation.

Thesis and Methodology Review

My thesis is USSTRATCOM is not currently postured to safely conduct the nuclear mission. I used two competing schools of thought from organization theory regarding safety in industries with hazardous technologies to assess the validity of my thesis. The high reliability school claims organizations with appropriate design and management techniques can safely manage extremely hazardous technologies, making serious accidents a very rare occurrence.¹ The normal accidents school claims serious accidents, while possibly rare, are inevitable over time, especially in technological systems with high degrees of interactive complexity and tight coupling.²

This study drew on Scott D. Sagan's ideas found in *The Limits of Safety* as the basis for the analytical framework for the study. However, instead of duplicating Sagan's methodology, I used it as a starting point. Unlike Sagan, I did not attempt to analyze a large number of case

¹ Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton, NJ: Princeton University Press, 1993), 14, 48.

² Sagan, *Limits of Safety*, 13, 28, 32.

studies. Instead, I primarily focused on the factors involved in the 30 August 2007 Bent Spear to provide the basis for determining USSTRATCOM's safety posture at that time. Then, I evaluated actions taken since that time to assess its current safety posture with regard to the nuclear mission.

My methodological approach was straightforward. I used the four interrelated factors the high reliability school claims are necessary and sufficient to make accidents in industries with hazardous technologies extremely rare, as the basis for chapters 3 through 6. In each chapter, I employed a four-step process. First, I provided an overview of the high reliability school's claims for one of the factors. Second, I covered the counterclaims made by the normal accidents school about the factor along with any areas of overlap or agreement. Third, I analyzed USSTRATCOM's safety posture in relation to the factor around the time of the Bent Spear. I did so first from the high reliability school's perspective, then from the normal accidents school's perspective, and finally in relation to any area of agreement between the two schools. Finally, for each factor, I examined relevant actions taken by USSTRATCOM in response to the Bent Spear and assessed their impact on its safety posture.

The purpose of this process was to identify any problems at USSTRATCOM that possibly contributed to the Bent Spear, to evaluate whether the problems persist or not, and to assess whether USSTRATCOM is currently postured to safely conduct the nuclear mission. Additional clarity about which school provides the better approach to ensuring the safety of the nuclear arsenal and the requirements associated with this approach was also expected. Again, none of the previous reports or investigations into the Bent Spear and other incidents used established frames of reference from organization theory to assess the problem of how to conduct nuclear operations in the

safest possible manner. This study did, and thus should inspire more confidence in its findings.

Conclusions

I present the conclusions from this study in three areas. First, I evaluate the two competing schools from organization theory. Second, I evaluate whether USSTRATCOM contributed to the Bent Spear. Third, I assess whether USSTRATCOM is currently postured to safely conduct the nuclear mission.

Evaluation of the Two Competing Schools

Nuclear weapons have been part of our daily lives for 66 years. This reality shows no sign of changing for the foreseeable future, and the United States is committed to maintaining a “safe, secure, and effective arsenal” as long as nuclear weapons exist.³ Both proponents and opponents of maintaining an arsenal agree on the abiding need for nuclear weapons safety. The high reliability school and the normal accidents school offer different approaches for maximizing nuclear weapons safety.

The high reliability school claims the following four critical factors are necessary for extremely reliable and safe operations: safety as a top leadership priority, high levels of redundant safety measures, a high reliability culture developed through decentralized decision-making and continually practiced operations, and sophisticated forms of trial and error organizational learning.⁴ The high reliability school argues that organizations or systems possessing these four factors have the necessary and sufficient ones to avoid serious incidents.⁵

Given its view of the inevitability of accidents and the effects of interactive complexity and tight coupling, the normal accidents school

³ Department of Defense, *Nuclear Posture Review Report* (Washington, DC: April 2010), iii, xiv; President, *National Security Strategy* (Washington, DC: May 2010), 23.

⁴ Sagan, *Limits of Safety*, 17.

⁵ Sagan, *Limits of Safety*, 27-28.

claims the best way to maximize safety is to avoid the combination of high interactive complexity and tight coupling.⁶ Furthermore, it argues the four factors cited by the high reliability school cannot overcome the structural effects of high interactive complexity and tight coupling, and might even be counterproductive.⁷

Sagan concluded that the normal accidents school's rationale better fit the actual circumstances of the numerous close calls he discovered studying nuclear weapons incidents.⁸ Accordingly, he agreed with the normal accidents school that changing the structure of the nuclear arsenal to avoid the combination of interactive complexity and tight coupling was the best approach to maximize safety.⁹

However, the Bent Spear demonstrated that simply changing the structure might not yield the expected positive effect on safety. In fact, the Bent Spear showed that the bomber leg of the nuclear triad, the only leg in which the structure changed, suffered the greatest decline in safety. The change occurred in September 1991 when President George H. W. Bush took the bombers off alert.¹⁰ This action physically removed the nuclear warheads from the bomber force on a day-to-day basis, thus eliminating tight coupling as a structural characteristic. Ironically, Sagan considered this action a positive safety measure, but several reports cited it as a causal factor of the Bent Spear due to the pattern of neglect and lack of focus on the nuclear mission that ensued.¹¹

⁶ Sagan, *Limits of Safety*, 275.

⁷ Sagan, *Limits of Safety*, 44.

⁸ Sagan, *Limits of Safety*, 250, 252, 267.

⁹ Sagan, *Limits of Safety*, 275.

¹⁰ Lawrence Freedman, *The Evolution of Nuclear Strategy*, 3rd ed. (New York: Palgrave Macmillan, 2003), 422-23.

¹¹ Sagan, *Limits of Safety*, 9; Senate, *Air Force Nuclear Security: Hearing before the Committee on Armed Services*, 110th Cong., 2d sess., 12 February 2008, 8; Defense Science Board Task Force on Nuclear Weapons Surety, *Report on the Unauthorized Movement of Nuclear Weapons* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, April 2008), 11-13, 15; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase I Report: The Air Force's Nuclear Mission* (Arlington, VA: September 2008), 22-23, 52-53.

The structure of U.S. nuclear forces, as reflected in the alert posture and triad, has not changed since September 1991—bombers off day-to-day alert, ICBMs on alert, and a significant number of SLBMs at sea on ballistic missile submarines at any given time.¹² The 2010 Nuclear Posture Review (NPR) effectively ruled out Sagan's recommendation to change the structure further, based on the decision to retain the current alert posture indefinitely and the nuclear triad for at least ten years.¹³ The fact that the ICBM and SLBM legs of the triad will retain their interactive complexity and tight coupling characteristics indefinitely and that safety actually worsened after changing the bomber leg's structure, suggest the high reliability school may provide a more useful and realistic approach to maximize nuclear weapons safety.

Additionally, the continued fact that no accidental or unauthorized nuclear detonations or accidental nuclear wars occurred in the 18 years since Sagan published his findings further undermines his and the normal accidents school's claims.¹⁴ These did not occur despite the many problems noted in the U.S. arsenal and concerns about proliferation and loose nuclear material abroad.¹⁵ None of this suggests Sagan's findings are without merit. It does suggest that maximizing nuclear weapons safety is not as easy as simply removing the combination of high interactive complexity and tight coupling.

¹² Department of Defense, *Nuclear Posture Review Report*, 27.

¹³ Department of Defense, *Nuclear Posture Review Report*, ix-x, 19-27. Sagan also recommended developing safer warheads, with the nuclear material kept separate from their detonation devices in peacetime. The 2010 NPR also ruled out this recommendation, because it forbids new warhead development and supports only the minimum necessary refurbishment, reuse, and replacement of components to sustain the service life of each warhead. Of these three sustainment options, the NPR views replacement of components as the last resort option. Sagan's recommendation is also less relevant, since the most recent warhead designs use insensitive high explosive (IHE) detonators instead of conventional high explosive types. The IHE detonators can withstand fire and impacts and greatly reduce the chance of accidental high explosive detonation. See Sagan, *Limits of Safety*, 276; Department of Defense, *Nuclear Posture Review Report*, 39; Senate, *Air Force Nuclear Security*, 80, for details.

¹⁴ Sagan, *Limits of Safety*, 267-68.

¹⁵ Sagan, *Limits of Safety*, 266-67; President, *National Security Strategy*, 1, 3-4, 8, 17, 20, 23; Department of Defense, *Nuclear Posture Review Report*, iv-vii, 9-13.

However, one should not dismiss the normal accidents school's claims about tight coupling and interactive complexity. If possible, one should reduce or eliminate tight coupling and interactive complexity. This is not always possible though, and sometimes one must manage systems with high interactive complexity and tight coupling as safely as possible, such as the ICBM and SLBM forces.

Similarly, one should not dismiss the normal accidents school's counterclaims with regard to the high reliability school's four factors. The counterclaims provide useful cautionary notes. For example, the school's claim that safety is only one of a number of competing leadership priorities provides awareness to organizational leaders that could help them guard against other priorities that might undermine their safety goals.¹⁶

USSTRATCOM and the Bent Spear

USSTRATCOM contributed to the Bent Spear, despite General Chilton's claims that USSTRATCOM had not lost its focus on the nuclear mission, and that problems had been isolated to the Air Force.¹⁷ In fact, USSTRATCOM shared many of the same problems as the Air Force with regard to the nuclear mission, including a loss of focus.¹⁸ The Air Force was directly responsible for the Bent Spear, but USSTRATCOM was indirectly responsible, since it failed to act as a demanding customer of the Air Force. Its own loss of focus caused USSTRATCOM to fall short as the focal point for the nuclear deterrence mission within the DoD.

¹⁶ Sagan, *Limits of Safety*, 44.

¹⁷ Michael Hoffman, "New Focus on Nukes – Exclusive Interview: Leader Spells Out StratCom's Plans to Support Air Force Mission," *Air Force Times*, 13 October 2008.

¹⁸ Department of Defense, *Nuclear Posture Review Report*, 43; Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase II Report: Review of the DoD Nuclear Mission* (Arlington, VA: December 2008), 55; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7, 11; Defense Science Board Task Force on Nuclear Deterrence Skills, *Report* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, September 2008), 52, 55.

USSTRATCOM began very much as a continuation of SAC in 1992 and remained focused on the nuclear mission until 2002. At that crucial point, in the aftermath of 9/11, the need to sustain its focus became more critical than ever as the DoD as a whole shifted its focus further away from nuclear weapons to fight the *war on terror*. However, by the time of the Bent Spear, USSTRATCOM had gone from a command with one mission, nuclear deterrence, to a command with eight global missions. In 2002, USSTRATCOM assumed the responsibilities of USSPACECOM and inherited its space operations, missile defense, and IO missions.¹⁹ In 2003, USSTRATCOM took ownership of the previously unassigned (non-nuclear) global strike and C4ISR missions.²⁰ In 2006, it gained the global network operations and combating WMD missions.²¹ One clear result of the mission proliferation at USSTRATCOM, which came without the necessary manpower authorizations and personnel, was the loss of focus on the nuclear mission.²²

The rationale behind USSTRATCOM's mission proliferation came from three primary sources. First, since the end of the Cold War, the altered security environment and attainment of unrivaled conventional military superiority have marginalized nuclear weapons' role in U.S. national security.²³ USSTRATCOM's added missions reflect this reduced role for nuclear weapons.

¹⁹ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53.

²⁰ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53; United States Strategic Command, "History," <http://www.stratcom.mil/history>.

²¹ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53.

²² Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 53-58; DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7, 11, 13, 18; DSB Task Force on Nuclear Deterrence Skills, *Report*, 52, 55.

²³ Freedman, *Evolution of Nuclear Strategy*, 424-26, 464; Thomas G. Mahnken, *Technology and the American Way of War* (New York: Columbia University Press, 2008), 221; Benjamin S. Lambeth, *The Transformation of American Air Power*, (Ithaca, NY: Cornell University Press, 2000), 153; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, Chairman's Opening Letter; Congressional Commission on the Strategic Posture of the United States, *America's Strategic Posture: Final Report* (Washington, DC: United States Institute of Peace Press, 2009), xv; DSB Task Force on Nuclear Deterrence Skills, *Report*, 14.

Second, much of the rationale for USSTRATCOM's mission growth is traceable to the 2001 NPR and implementation of its new deterrence strategy, which envisioned a reduced role for nuclear forces in deterrence, while expanding potential options for the president.²⁴ In addition to a potential nuclear response, the new strategy included non-nuclear strike options (both kinetic and non-kinetic), active and passive defenses combined with warning capability, and responsive weapons infrastructure, all enabled by enhanced C2, intelligence, and planning.²⁵ The *new strategic triad* embodied this new strategy—see figure 1.

Third, perhaps the most pivotal, yet easiest source to overlook for the rationale behind USSTRATCOM's mission proliferation is the word *strategic*. Of all the things USSTRATCOM inherited from its SAC predecessor—see chapter 1—the shared name *strategic* is arguably the most important. *Strategic* is a poorly understood term, loosely defined adjective, and undisciplined way to describe certain weapons, weapons systems, or military commands.²⁶ In military terms, one should use the word *strategic* to describe decision-making about the context of war and preparation for war.²⁷ The use of *strategic* in USSTRATCOM's name implies that the other unified commands are somehow non-strategic—an absurd distinction. Keeping the strategic name allowed USSTRATCOM to become a jack-of-all-trades, gaining every mission deemed important but not currently assigned to another command or closely aligned to another command's mission.

Many of the problems identified at USSTRATCOM mirrored those found across the DoD—declining nuclear expertise and focus on the

²⁴ Robert D. Critchlow, *Nuclear Command and Control: Current Programs and Issues*, (Washington, DC: Congressional Research Service, The Library of Congress, 3 May 2006), 9-11.

²⁵ Critchlow, *Nuclear Command and Control*, 9-10; United States Strategic Command, "History," <http://www.stratcom.mil/history>.

²⁶ Colin S. Gray, *Explorations in Strategy*, (Westport, CT: Praeger Publishers, 1996), 61.

²⁷ Everett Carl Dolman, *Pure Strategy: Power and Principle in the Space and Information Age*, (New York: Frank Cass, 2005), 13.

nuclear mission, inadequate senior level interest, weak advocacy, and a lack of appreciation of the continued necessity of a strong nuclear deterrent. These problems manifested themselves in inadequate oversight, inspections, exercises, resources, training, and proficiency.²⁸ USSTRATCOM's shortfalls definitely contributed to the Bent Spear and other incidents discussed in chapters 3 through 6. The Bent Spear and other incidents were symptoms of the Air Force's caretaker approach toward the nuclear mission, which USSTRATCOM not only failed to address but also adopted.

Thesis Validity

Given the evidence presented in this study, I conclude that USSTRATCOM is not currently postured to safely conduct the nuclear mission, although its safety posture today is much stronger than it was in 2007. The high reliability school sets a very high bar for safety for organizations to meet. USSTRATCOM falls short of the mark set by the high reliability school for each of its four factors. In short, the nuclear mission suffered a long decline, and though progress is evident, the long, uphill climb required in order to return it to prominence and priority is in the very early stages.

For example, there are many indications that although the nuclear mission now holds an increased level of importance at USSTRATCOM, they are not enough to make nuclear weapons safety a top leadership priority. For instance, having a J3N flag officer is an improvement over having a colonel as the focal point for the nuclear mission within USSTRATCOM headquarters, but it is also a tacit admission that the USSTRATCOM commander cannot completely focus on the nuclear mission and nuclear weapons safety. Responsibility for eight global missions simply does not allow it. Additionally, nuclear C2 is the only

²⁸ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 7, 11, 13, 18; DSB Task Force on Nuclear Deterrence Skills, *Report*, vi, viii-ix, 36-37, 55; Task Force on DoD Nuclear Weapons Management, *Phase II Report*, ix-x, 34-35, 53-58, 65.

mission described as a *legacy* mission on USSTRATCOM's own website, implying the nuclear mission is outdated.²⁹ Finally, the headquarters does not even track nuclear weapons safety mishap data.³⁰

In addition, as far as redundancy, there are still gaps in USSTRATCOM's overlapping safety redundancy, and the need for improvement remains to leverage the full potential of redundant measures to maximize safety. Similarly, there is room for improvement in terms of culture, decentralization, and continuous operations. For example, USSTRATCOM does not send enough inspectors to observe nuclear inspections adequately. In the area of procedures, USSTRATCOM's oversight and review does not extend beyond operations, foregoing opportunities to examine procedures for maintenance and other mission support activities. Furthermore, it remains difficult to provide challenging on-going nuclear operations in the bomber leg without daily alert. Finally, USSTRATCOM and the force providers have not fully embraced the high reliability school's calls for a proactive approach to promote organizational learning through sophisticated trial and error efforts.

The main impediment for USSTRATCOM's nuclear safety posture remains its number of missions. The command still has eight global missions (nuclear deterrence, space operations, cyberspace operations, missile defense, IO, global strike, ISR, and combating WMD) with more responsibilities on the way.³¹ The recently approved 2011 Unified Command Plan expands USSTRATCOM's responsibility for combating WMD and requires it to develop a global missile defense concept of

²⁹ United States Strategic Command, "About USSTRATCOM," <http://www.stratcom.mil/about/>; Merriam-Webster Online Dictionary, s.v. "legacy," <http://www.merriam-webster.com/dictionary/legacy> (accessed 2 April 2011).

³⁰ Bobby Neal, USSTRATCOM civilian, to the author, e-mail, 4 January 2011. The author was informed that USSTRATCOM is not the repository for such data.

³¹ House Committee on Armed Services, *Statement of General C. Robert Kehler, Commander, United States Strategic Command, before the Subcommittee on Strategic Forces*, 112th Cong., 1st sess., 2 March 2011, 1.

operations.³² This summer USSTRATCOM will also assume responsibility for the Joint Warfare Analysis Center from U.S. Joint Forces Command.³³

USSTRATCOM touts the synergy of its many missions, but friend and foe could easily view it as a jack-of-all-trades with too many competing missions.³⁴ This view represents an unacceptable perception of USSTRATCOM, and perception means everything when it comes to nuclear deterrence and assurance, for it is the perception of U.S. nuclear forces in the adversary or ally's mind that ultimately deters or assures.³⁵

Implications

Instead of treating the high reliability and normal accidents schools as an either/or choice, the best approach to safety could result from the combination of the two schools' approaches. Organizations should recognize that both schools provide useful insights for maximizing safety. In general, the optimum approach would likely result from eliminating or reducing tight coupling and/or interactive complexity, while adhering to the high reliability school's four factors and guarding against the counterclaims made by the normal accidents school. Moreover, one should recognize that the high reliability school's guidance could help any organization seeking to maximize its safety posture, while the normal accidents school's counterclaims play a useful devil's advocate role. The Bent Spear demonstrated that merely changing the structure without adhering to the high reliability school's four factors

³² Department of Defense, *News Release: DOD Releases Unified Command Plan 2011* (Washington, DC: Office of the Under Secretary of Defense for Public Affairs, 8 April 2011), <http://www.defense.gov/Releases/Release.aspx?ReleaseID=14398>.

³³ Air Force Association, "JFCOM Reassignments Approved," AirForce-Magazine.com, 3 May 2011, <http://www.airforce-magazine.com/DRArchive/Pages/2011/May%202011/May%2003%202011/JFCOMReassignmentsApproved.aspx>.

³⁴ United States Strategic Command, "About USSTRATCOM," <http://www.stratcom.mil/about/>.

³⁵ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, iv; Strategic Posture Commission, *America's Strategic Posture*, 22.

is not a wise approach, because it can lead to neglect and complacency toward the hazardous technology activity.

One should also recognize that the two schools are not completely at odds with one another. There are some areas of agreement between the two schools—see table 1. For instance, both the high reliability and normal accidents schools agree that the ideal military model, characterized by isolation from society, intense socialization, and strict discipline, can enhance safety by fostering a culture of reliability.³⁶ Additionally, neither school provides a precise estimate of the number of serious accidents one should expect to occur if an organization follows its recommendations.³⁷ In short, organizations may improve safety by treating the two schools as complementary versus competitive.

Recommendations

First, the DoD should reduce the number of USSTRATCOM's missions, so that it can better focus on the nuclear mission and help ensure nuclear weapons safety. This was also a recommendation of the 2008 Task Force on DoD Nuclear Weapons Management that the DoD has thus far not adopted this proposal.³⁸ As this study has shown, in terms of maximizing nuclear weapons safety, the optimum number of missions for USSTRATCOM is one—the nuclear mission. Again, nuclear weapons safety is just one aspect of the nuclear mission. Therefore, in order for nuclear weapons safety to become a top priority at USSTRATCOM, the nuclear mission itself must become the priority, and the command must be free to focus on the nuclear mission.

The United States will have nuclear weapons for a very long time, and therefore needs to have a combatant command that is postured to provide the leadership required in order to sustain a safe, secure, and

³⁶ Sagan, *Limits of Safety*, 50.

³⁷ Sagan, *Limits of Safety*, 47-48.

³⁸ Task Force on DoD Nuclear Weapons Management, *Phase II Report*, 54, 58.

effective arsenal.³⁹ Rather than decreasing, this need will only grow in importance as America continues to diminish the role of nuclear weapons and works toward a world free of such weapons.⁴⁰ The nuclear mission is one of many missions for the greater DoD and the force providers. As the focal point for the nuclear mission, USSTRATCOM must have a dedicated focus on the mission, because nuclear deterrence and assurance for the United States and its allies depend on it. If USSTRATCOM could focus solely on the nuclear mission, it could provide the best possible oversight and support to the force providers below it, and the best possible advocacy to those above it in DoD's nuclear hierarchy.

Second, the USSTRATCOM commander should send a strong signal that the nuclear mission is the command's top priority by reclaiming direct ownership of the day-to-day mission from JFCC-GS and reabsorbing its nuclear responsibilities within the headquarters. These actions would not only send a strong signal to all observers that the nuclear mission is the commander's top priority and daily focus, they would also streamline the nuclear hierarchy within the command. The hierarchy became more complicated with the addition of the J3N to the preexisting six nuclear task forces (TF), JFCC-GS, and the residual headquarters staff—see chapter 1 for discussion.

In addition, having the USSTRATCOM commander directly in charge would yield other benefits, such as adding prestige to the mission and clearing up a discrepancy in terms of the rank of those within USSTRATCOM who are responsible for the nuclear mission. The JFCC-GS commander is still a two-star general officer.⁴¹ As such, he is

³⁹ DSB Task Force on Nuclear Weapons Surety, *Unauthorized Movement Report*, 19; Department of Defense, *Nuclear Posture Review Report*, iii, xiv, 43; President, *National Security Strategy*, 23.

⁴⁰ Department of Defense, *Nuclear Posture Review Report*, 43.

⁴¹ United States Strategic Command, "Mission Briefing," (version 11-03, 28 January 2011).

currently outranked by two of his subordinate TF commanders, all the other three-star JFCC commanders, and the USCYBERCOM commander—a four-star general officer.⁴² Furthermore, these actions would put a premium on selecting future commanders with formative experience in nuclear operations and make it harder for future commanders to shift their focus away from nuclear deterrence.

Finally, the DoD should rename USSTRATCOM. The DoD should take this action whether USSTRATCOM's number of missions decreases or not. Again, *strategic* is a poorly understood term, loosely defined adjective, and undisciplined way to describe certain weapons, weapons systems, or military commands.⁴³ This claim obviously includes nuclear weapons. Unfortunately, some continue to differentiate between *strategic* and *tactical* nuclear weapons. This distinction is only useful for treaty purposes.⁴⁴ Clearly, any threat or actual use of any nuclear weapons would have strategic effects.⁴⁵ Thus, the DoD should rename USSTRATCOM even if it only had responsibility for the nuclear mission.

Renaming USSTRATCOM would force an evaluation of its missions to see if one or two words could adequately describe or cover what USSTRATCOM does. A noun would be better than an adjective, as is the case with U.S. *Transportation* Command. A renaming would also force a recognition at the combatant command level of the blurred line between the different levels of war that the Air Force recognized when it reorganized in 1992 when it placed all combat aircraft under Air Combat Command.⁴⁶ No current unified command has more than two words for its name, not counting *United States* and *command*. If the DoD could not

⁴² United States Strategic Command, "Mission Briefing," ver. 11-03.

⁴³ Gray, *Explorations in Strategy*, 61.

⁴⁴ Amy F. Woolf, *Nonstrategic Nuclear Weapons*, (Washington, DC: Congressional Research Service, 2 February 2011), 5-6.

⁴⁵ Gray, *Explorations in Strategy*, 62.

⁴⁶ Thomas A. Hughes, *Over Lord: General Pete Quesada and the Triumph of Tactical Air Power in World War II*, (New York: The Free Press, 1995), 19.

find a suitable new name for USSTRATCOM in one or two words, this would provide a strong indication that it has too many missions and its focus is too broad.

Lessons

If there is one overarching lesson to learn from the Bent Spear episode, it is that USSTRATCOM and other nuclear organizations must stay vigilant and not let complacency creep into nuclear operations. This threat grows, as we get further away from Bent Spear. Proposed budgets for the nuclear arsenal and supporting infrastructure look promising for the next decade, but it is hard to predict if reinvigoration efforts will last, given the constrained budgets expected overall, multiple competing priorities, and on-going operations.⁴⁷ In addition, USSTRATCOM's multiple missions and current organizational structure allow its commander to shift focus away from the nuclear mission, as happened previously. There is added cause for concern given the stated goal of continuing to diminish the role of nuclear weapons in U.S. national security.⁴⁸ The natural tension will remain between reducing and eventually eliminating reliance on nuclear weapons and the need to maintain a safe, secure, and effective arsenal.⁴⁹ Going forward, as the focal point for the nuclear mission within the DoD, the need for USSTRATCOM to provide strong nuclear leadership will only grow in light of these factors.

Suggested Area for Further Investigation

⁴⁷ Air Force Association, "Not Chump Change," AirForce-Magazine.com, 18 May 2010, <http://www.airforce-magazine.com/DRArchive/Pages/2010/May%202010/May%2018%202010/NotChumpChange.aspx>.

⁴⁸ Department of Defense, *Nuclear Posture Review Report*, iii, v-vi, 15-17, 48.

⁴⁹ President, *National Security Strategy*, 23; Department of Defense, *Nuclear Posture Review Report*, iii, v-vi, xiv, 45-49; Strategic Posture Commission, *America's Strategic Posture*, xi.

An interesting paradox to investigate further emerged in the course of this study. The United States intends to make deterrence of nuclear attack the sole purpose for its nuclear arsenal.⁵⁰ However, if it attempts to do this through strengthened conventional capabilities as it has suggested, this might actually increase the attractiveness of nuclear weapons for those countries that do not have warm relations with the United States.⁵¹ Indeed, several authors have noted the tendency for conventional dominance to encourage various unconventional responses, from high-intensity nuclear attacks, to low-intensity guerilla and terrorist attacks.⁵² Thus, a natural topic for investigation would be the relationship between U.S. conventional dominance and nuclear proliferation for various potential adversaries. Iran and North Korea immediately come to mind for possible case studies, but there are many more possibilities. This possible research area could prove valuable to U.S. policy makers by informing them on the possible competing efforts to reduce reliance on nuclear weapons and the growing need for effective counterproliferation.

⁵⁰ Department of Defense, *Nuclear Posture Review Report*, 16-17.

⁵¹ Department of Defense, *Nuclear Posture Review Report*, 17; Freedman, *Evolution of Nuclear Strategy*, 426.

⁵² Freedman, *Evolution of Nuclear Strategy*, 412-13, 457; Mahnken, *Technology and the American Way of War*, 225; David J. Lonsdale, *The Nature of War in the Information Age: Clausewitzian Future* (New York: Frank Cass, 2004), 10.

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